THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
The Troubles of the Electrical Manufacturer	85
Municipal Telephone Troubles	86
Some Remarks Regarding Railway Electrification	88
Electric Gold Dredging (*illus.*)	89
Side-Street Lighting	90
Correspondence	91
New Electrical Devices, Fittings, and Plant (*illus.*)	94
Legal	95
Business Notes	96
The Marylebone Municipal Electrical Undertaking (*illus.*) ...	103
City Notes	113
Electric Tramway and Railway Traffic Returns	118
Stocks and Shares	118
Share List of Electrical Companies	119
Proceedings of Institutions:—	
Some Notes on the Breaking of Trolley Wires (*illus.*) ...	121
The Track Circuit as Installed on Steam Railways (*illus.*)	122
Notes on the Evolution of Canal Electrification Methods (*illus.*)	124
Of Technical Literature	126
New Patents Applied For	128
Published Specifications	128

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THE

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THE TROUBLES OF THE ELECTRICAL MANUFACTURER.

THAT the electrical industry is in a precarious condition will be denied by no one. It is true that in some branches of electrical manufacturing there has been a moderate degree of prosperity, but it is equally true that the manufacture of machinery has become distinctly unprofitable. We have drawn attention more than once in these columns to the extraordinary disparity between the prices which obtained some three or four years ago and those which exist to-day, and it is no exaggeration to say that the difference is in the neighbourhood of thirty to forty per cent. The depressed condition of this branch of electrical engineering has been amply demonstrated by the balance sheets of the manufacturing companies, and, bad as they have been in the past, we fear that worse remains behind. It can have hardly added to the joys of the manufacturer to know that much of his unprofitable work has been done for the benefit of the municipalities whose methods of payment and general attitude towards contractors are in no sense helpful to a struggling industry.

There has been a moderate demand for electrical plant for some time past, and we believe such demand exists at the moment, and is likely to continue for a considerable period; moreover, the condition of many of the principal workshops suggests that they are well off as regards output, but on every hand one hears the lament of low prices. One has witnessed a rather curious phase in selling which has at some time or other affected nearly every firm. With the prospect before them of empty shops, many firms have rushed into the market and procured work at any price, and after a few repetitions of such actions, it is not surprising that a general depression in prices should have resulted. This incident alone is distinctly instructive and serves to show that the manufacturer is afraid of the position; and there is ample justification for his fear, because a close student of affairs must have long recognised that, despite the considerable demand for heavy machinery, this section of the industry is suffering from over-production.

There has been a fatal fascination about electrical manufacture, and we are paying the penalty of its attractiveness. Probably there is no more difficult business in the world than the manufacture and supply of electrical machinery, and though it has not suffered from lack of brains or capital, the results obtained have been miserable in the extreme. Having arrived at this pass, the question naturally arises as to whether there exists a remedy for the present ills. It is probably a callous doctrine to urge, but the destruction of the weakest—if it were a speedy one—would unquestionably benefit the strongest; but we are afraid there would be a dispute as to which was the weakest. Yet if the electrical manufacturers were to agree among themselves as to which should go out of the business, they would be conferring benefits not only

upon those who remained, but equally upon those who went. But we are afraid that agreement among manufacturers is almost impossible. An attempt was made some time ago to arrive at an understanding in regard to engine prices, and, after much deliberation, a code of rules was drawn up, under which each tenderer was to add five per cent. to every engine price. It appeared a small thing to confer and deliberate upon, but it proved difficult and even impossible to achieve, for while every manufacturer was in accord with the idea, and, indeed, promised to abide by it, the bond of union was soon dissolved, for the most enterprising, while faithfully adding five per cent. to the engine section of his tender reduced the dynamo price accordingly. It was not surprising under these circumstances that prominent manufacturers should have promptly broken away from the combination of interests, and the consequence is that cutting competition is still rife.

No one can deny that an understanding among manufacturers as to minimum prices would have prevented much of the ridiculous rivalry which exists to-day, because, while everyone admits the desirability of competition, even the keenest buyer must deplore the absurd prices which exist. Materials are daily becoming more costly, yet this fact apparently has no effect on the price of machinery, and we are afraid that quality will inevitably suffer, and this is where the buyer becomes most seriously affected. We are told that attempts are being made to bring manufacturers together again for the purpose of correcting prices, but while most firms have evinced a readiness to participate in such an arrangement, we fear the movement is not likely to succeed, because it is commonly understood that two or three firms are strongly opposed to a combination, and if no permanent good resulted from the arrangement in regard to engine prices when all the manufacturers were in accord, we fail to see that a successful issue can be expected if one or two refuse to fall in with the present scheme. Moreover, if the present troubles of electrical manufacturers are due to over-production, any combination or arrangement would merely boost up the weakest, and that from every point of view is most undesirable.

MUNICIPAL TELEPHONE TROUBLES.

Every objection urged by those who opposed the granting of telephone licences to the municipalities has been thoroughly justified by actual events during the short history of municipal telephony. Expert witnesses showed at the various telephone inquiries held before the passing of the Telegraph Act of 1899, that the estimates on which the municipalities based their telephone schemes were fallacious, and fallacious they have been proved by the hard test of actual practice. At Glasgow, where the biggest experiment in municipal telephony was made, the capital expended per working subscriber's line was twice the estimated figure. Having found, within about four years from the start, that their telephone undertaking had got into a hopeless condition, both technically and financially, the Glasgow Corporation were glad to use their influence with the Government to get the plant taken over by the Post Office at a relatively small loss. Each other telephone-owning municipality has had a similar experience, with the exception of the much-desired sale to the Post Office. This has not yet occurred at Hull, Portsmouth and Swansea, but the Town Councils at each of those places have found that the cost of conducting the telephone business is far greater, and the difficulties more numerous, than they were led to believe at the beginning. At Portsmouth and Swansea efforts have been made to sell to the Post Office, but in each case there is such a wide gap between the Post Office idea of value and the municipal figure of capital cost that the municipal telephone committees, flouting the Rothschild injunction to "cut short your losses" (the losses in this case, of course, are the ratepayers') struggle on with concerns that daily become more disorganised.

One of the objections made by Sir William Preece to the starting of municipal telephone systems was to the effect that, as telephony is an extremely technical business, there would be difficulties of management under municipal control, resulting in lack of uniformity and lack of technical progress. This difficulty has been glaringly exemplified in practice. Glasgow handed over to the Post Office a telephone system equipped after the fashion of the early nineties, and in each of the other municipal telephone systems the plant, while differing in various particulars, is hopelessly out of date. Not only has the technical management been feeble in the extreme, but, as appears at least in one case—curiously enough, that of the municipal telephone system which on paper has shown the most flourishing results—the commercial management and organisation have been about as bad as they could be. At the Portsmouth Town Council there occurred early this month a debate on the management of the Portsmouth municipal telephone system which might well make the most ardent municipal trader pause and think. A short time ago the Portsmouth Telephone Committee found it necessary to dismiss their manager on account of serious irregularities. Since that time the Committee and the borough treasurer have been investigating, and after one or two stifled discussions, the results of the investigations were fairly fully ventilated at the recent debate by an outspoken member of the Committee. The borough treasurer reported that he found the stores records of the telephone department, which he had examined for suspected leakages, "so incomplete and of such a meagre character that it would be impossible to come to any definite conclusion."

Mr. Felton, the outspoken member of the Telephone Committee, said that the whole history of the business "had been rotten from the beginning." A more unbusiness-like way of conducting affairs he had never seen. An angel from heaven could not convert the men who had been so lax in the past. They had charged revenue expenditure to capital, they had six pages of bad debts, extending back to the beginning of the undertaking, and they could not count profits until bad debts had been written off. There had been defalcations, and names of men who did not exist had been carried on the pay-rolls. Their statistics were wrong, as the stations disconnected had not been deducted. The undertaking had got entirely beyond the chairman's control; and so on, to an alarming extent.

The chairman's reply to this indictment was a more emphatic condemnation of municipal management of technical businesses than the indictment itself. The sub-

stance of it was that if they appointed an official, and paid him sufficiently, they had a right to assume that he was an honest man. That was what the Committee did. "The late manager," added the chairman, "demoralised the whole of his staff, young and old, and did so wilfully and knowingly and maliciously." This is said by the man who has been continuously chairman of the Committee since the start of the enterprise, over four years ago, of the man who was manager of the enterprise from the start until his summary dismissal a few months back. It is this thoroughly lax and inefficient management which is one of the greatest arguments against municipal trading. The idea that any local resident who may be elected to a Town Council at once becomes invested with the capacity, experience and technical knowledge requisite for the proper supervision of a business involving a costly and complicated plant, a large technical staff and heavy capital and annual expenditures, is one of the most stupid and unwarrantable of the many stupid notions with which Socialism is honeycombed. The idea which possesses the heterogeneous combination of men forming a Town Council, that a young and inexperienced man at a starvation salary of £200 or £300 a year, may, without any expert supervision, be entrusted with the sole management of a technical and progressive business, with a plant costing £50,000 to £100,000, a staff of a hundred or more, and a turnover of £10,000 to £20,000 a year, is another stupid notion which follows in quite natural sequence from the first. A dishonest and demoralising manager is, of course, the exception, though no dishonest and demoralising manager could remain in sole control of a commercial concern for four years. But it is the false and stupid assumptions we have referred to, which are widely prevalent throughout the country, which render municipal trading in technical businesses so unsound, and have made such a complete failure of municipal telephony.

Glow Lamp Standards.

This week the long-expected Specification for Carbon Filament Glow Lamps has been issued by the Engineering Standards Committee, by whom, we believe, it is regarded as of exceptional importance. The subject is one which abounds in difficulties, but probably no single piece of electrical apparatus stands in greater need of standardisation than the carbon glow lamp, and we hope to see the specification quickly and generally adopted throughout the whole industry, in order that its benefits may be fully realised.

It may be suggested that the specification comes too late; that the carbon filament has seen its best days, and will shortly retire to the limbo of the obsolete, before the triumphant march of its metallic rival. With this view we do not agree; remarkable developments have taken place of late, it is true, and we hope to see the day of the 200-volt 1-watt-per-candle lamp, but that day is not yet. It should be borne in mind that the United Kingdom stands almost alone in the general employment of supply pressures between 200 and 250 volts, though we have little doubt that the pressures in use abroad will tend upwards towards the same level in the future; we also rejoice in the fact that the cost of electricity for lighting rules lower in this country than abroad—a result in no small degree due to the practice above mentioned. These facts respectively compel and condone in some measure the continued use of carbon glow lamps, in spite of their admittedly lower efficiency. The metallic filament lamp will doubtless attain a wide vogue in situations where low voltage is obtainable, especially in private installations; but on public supply circuits it is not at present available except where large candle-powers are required.

Granting the carbon filament, therefore, a few years' respite, what is the present position? The quality of the lamps is, beyond question, very erratic; there is no independent check upon it, and as for makers' guarantees—well, the less said the better. It is well known that 220-volt lamps of 16 c.p., reputed 60-watt lamps, take anything from 70 watts upwards during their brief lives, and they vary widely in candle-power. Consumers are entirely at the mercy of dealers, except in the rarest instances, and all sorts of abominations are supplied to them, whether in good faith or not is immaterial. It is a trite, but true, saying, that the business of electric lighting undertakers is to sell *light*; but only too many—the vast majority, in fact—content themselves with reading the meters. No wonder, then, that consumers who are paying for 16 candles and receiving 8 are restive, and even rebellious; or that the gas interests are recovering lost ground. Even where lamps are systematically tested, in how many cases is the work in the hands of a competent tester? Next, perhaps, to calorific values, there is no measurement in common use in the electrical industry which is so difficult to conduct with accuracy as that of the candle-power and efficiency of lamps; yet it is so seemingly simple and easy that too often it is placed in the charge of an untrained youth, with results which are worse than worthless. Even when the practice is good, the apparatus is often inadequate and, above all, the standards unreliable.

Now that a definite specification has been drawn up, and accepted by the lamp makers, we hope to see a marked improvement in the lamps. It is true that the limits are somewhat wide, but perfection cannot be attained all at once, and the limits will be narrowed as time goes on. The makers of necessity will exercise a closer supervision over the processes of manufacture and classification. But the mere promulgation of even the most admirable rules and standards will not suffice to ensure the desired results; unless due provision is made for their enforcement the work will be futile.

It remains, therefore, to establish either local testing laboratories in competent hands, or a central testing laboratory through which all lamps must pass. The latter alternative would appear to be the most likely to give satisfaction, and could easily be made self-supporting, though it might require assistance in the early stages. Whatever means be adopted, it is absolutely essential to ensure the proper testing of the lamps. We give particulars of the contents of the specification in our "Notes."

The Reported Secret Syndicate in Germany.

The question of an alleged secret syndicate of the large firms in Germany, to which reference was made in this journal a few weeks ago, has again been brought forward in that country. The charges made against these firms is that they tender for public contracts at high prices where it is thought there will be no competition, whereas cutting prices are submitted where the rivalry of other contractors is expected, the gains in the one case being set against the losses in the other. It will be remembered that on the former occasion high prices were submitted by three of the alleged syndicated firms for plant required at Frankfort. Now the association of installation firms draws attention to an instance of an opposite character in reference to wiring tenders for the Homburg railway station buildings on behalf of the Frankfort Railway Administration. The tenders were as follows:—

No. 1	£590
„ 2	559
„ 3	451
„ 4	357
„ 5	225
„ 6	224

It is not stated which firm received the contract. No. 1 tender was submitted by a local or Homburg firm, who are declared to have made exact calculations so as to obtain the order and to be able to carry out the works at less expense than the others. The lowest tenders, Nos. 5 and 6, are stated to have been sent in by two of the firms comprised within the alleged syndicate. The prices are, to say the least, in marked contrast to those recorded in this journal on December 28th, as having been presented by the same firms for another contract.

D

SOME REMARKS REGARDING RAILWAY ELECTRIFICATION.

By PHILIP DAWSON.

A good deal has been heard recently of the unsatisfactory results obtained from the electrification of the Metropolitan District Railway, and from this so-called failure conclusions have been drawn by some, that electricity is not suitable for operating the surburban branches of our main line railways, and that the conversion of suburban lines to electric traction, so strongly recommended by the Royal Commission on London Traffic, is further off than ever.

Space will not permit of a thorough investigation of these allegations, or of the slender foundations on which they rest, but a few general remarks on the subject of the electrification of our railways, and how far the results of the Metropolitan District Railway can be applied to them, may perhaps be of interest.

If, for argument's sake, it be assumed that the electrification of the Metropolitan District has proved a failure (and on this point there is much to be said), such a failure would in no way militate against the certain success of electrification on suburban lines, provided the transformation is properly carried out, and the trains run on a proper schedule.

The two principal troubles of the Metropolitan District have been—first, that the working expenses instead of being decreased have increased; and secondly, that the increase, both in passengers carried and in receipts, does not appear to have realised the sanguine expectations of the promoters.

As regards the increased working expenses, there is little doubt that if the detailed figures were available, it would be found that the increase is largely due to the difference in method of operating trains electrically and by steam, such as, for instance, having a man on the platform of each carriage to open and shut the end doors and call out the names of the stations, instead of one guard in the rear van, as was the case when the line was operated by steam. This is only one out of many examples that could be given as to why operating expenses may be greater now than formerly, but it clearly shows that the increase is not necessarily due to the adoption of electric traction, but to a change in the methods of operation and management.

As regards the second point, there are no doubt several causes which have contributed to this phenomenon. Anyone who looks at the map of London will see that for a great portion of the way the majority of the lines of the Metropolitan and District Railways must suffer seriously from the competition of electric tramways and motor-omnibuses, and a further study of the map will also show that the Metropolitan District Railway is principally an urban railway, and not a suburban system, although the District and the Metropolitan lines, to a limited extent, act as suburban, as well as urban, railways. Unfortunately, the most important portion of these systems, viz., the inner circle—even when operated electrically—has not sufficient capacity to accommodate the large number of suburban trains which should run into the city in the morning and out again at night, and the result is neither satisfactory from the urban nor from the suburban point of view.

A great part of the Metropolitan and District services are circular services, and there is hardly any station which can be called a terminus; whereas, in the case of other railways, the majority, if not all the services, are what may be called terminal ones, involving a train coming into the station and going back the way it came, and this is a very important point of difference. Then, unfortunately for the Metropolitan and District Companies, they are burdened with a very heavy capital, and the introduction of electricity involved the scrapping of practically the whole of their rolling stock and steam locomotives. The general American methods adopted in the conversion did not prove the brilliant success which the American promoters had anticipated, and the numerous breakdowns and delays, which, in many cases, have undoubtedly been due to faulty materials or workmanship, have been made the most of by the daily Press, with the result that the general public do not, for the present, look too favourably on the system, and only patronise it if no other means of transit are available.

Sufficient has been said to show that there are many causes, entirely independent of the method of haulage, why electric traction may not have been the success which was anticipated by the promoters on the Metropolitan District lines. But outside this altogether, the causes which brought about the electrification of these particular systems are not the same as those which will bring about the electrification of the suburban systems of our main line railways, nor are the conditions under which the change will take place at all similar.

As has already been pointed out concerning the majority of our main lines, the suburban services are purely and simply suburban, and few, if any of the lines, are only used for urban work; in other words, the suburban lines radiate out of London, the distances run being from 10 to 20 miles, and past experience clearly shows that for anything above five miles or so, tramways and motor-omnibuses cannot compete with a frequent and rapid electric railway service. With steam traction the competition of tramways and motor-omnibuses is a very real danger, for owing to the slow acceleration possible with steam, the average speed of steam trains on suburban lines is not much over 12 miles an hour, and therefore not greatly superior to the average speed of the London tramways and motor-omnibuses. Furthermore, as the tramway service is very frequent, as compared to the railway service, people will naturally utilise the tramcars instead of the railways. The result of this is that railway companies are faced by one of two alternatives: either they must decide entirely to abandon suburban services, or else they must face the substitution of electricity for steam on these lines. Such substitution in their case will not necessarily mean a scrapping of all their rolling stock and locomotives, as was done in the case of the Metropolitan and District, as there is no reason why a considerable portion of the existing coaches should not be utilised for electric traction, and the locomotives could be utilised on other portions of their steam system.

But there is another and even more important consideration in the case of railways which should lead them to electrification, and that is the restricted capacity of many of the big London termini, as, for instance, Victoria, London Bridge, Cannon Street, Liverpool Street, &c. For at present with suburban services which in no way approach that frequency of trains which would be required in order to compete sucessfully with electric tramways, many of our railways are not only constantly forced to increase the number of their lines into London, but also the size of their terminal stations at a cost which very soon mounts into millions.

In most of the London termini the proportion of local trains to main line trains is very great, and anything therefore which will decrease the time required to clear a platform after the arrival of a train, and render it possible for another train to come alongside, will be equivalent to enlarging the terminus. It is just this saving of time which is effected by the multiple-unit electric trains which can evacuate a platform in from one half to one third the time that is possible with the present steam trains. The result, therefore, of the electrification of most of the suburban systems of the railways entering London would practically be to double not only the capacity of the existing lines leading into London, but also what is even more important, the capacity of the termini themselves.

It will, therefore, be seen that even if no saving were effected in the working costs by the introduction of electricity, great and real advantages would accrue from its introduction, and it is the reasons which have been given, and not the possible, or even probable, saving in working costs, which will eventually induce our railway companies to adopt electric traction for operating their suburban trains. As regards the question of working costs, if, as appears probable, railways put up their own power stations, or if electricity be available at anything like the price which the railway load factor and modern plant should make possible, it is at once evident that with a properly installed system there must be a considerable saving by operating suburban railways electrically, as compared to steam, provided (and of this there should be little fear) the trains are operated on a rational basis and proper rolling stock and general management is forthcoming.

We now come to what should be considered one of the most important factors connected with the question of electrification, and that is the type of rolling stock which should be used; it is regrettable that American ideas should have prevailed so much on the District Railway as to cause, what the writer considers, a very unprofitable type to be adopted on that line. One of the greatest benefits of electric traction is the high average speed which can be obtained, and it is, therefore, important, where stations are not far apart, to curtail as much as possible the stoppages at stations. The end-entrance American type of carriages militates very much against rapid filling or rapid emptying, and also encourages "strap hanging," as it is necessary to be near the end of the carriage in order to get out quickly. It furthermore delays a crowded train if the passengers in the middle of a carriage have, in order to get out, to push their way not only through a standing crowd at the ends of the carriage, but also against a torrent of people who wish to get into the carriage. Where trains run into the termini this point is of the greatest importance, as it is at the termini that the trains are at their fullest, both on arrival in the morning and on departure in the evening, and in order, therefore, to save as much time as possible, it is essential that the carriages should be of such design as to fill and empty as quickly as possible, and the only method of arriving at such a result is by adopting side doors. That the District Railway realised something of this is clear from the fact of their having adopted one centre door, but the disastrous failure of this centre door is too well known to be again dealt with here. It has been contended that side doors are wrong because passengers have to run the whole length of the train to find empty compartments. To obviate this inconvenience it is only necessary to adopt the system in use on the German State Railways in connection with their Berlin and Hamburg suburban services. This arrangement consists in cutting about 18 in. off each seat in each compartment, thus enabling the passenger who gets into a full compartment to pass through into the next one, and there is no doubt in the writer's mind that something of this sort is the right, and the only right, form of carriage to be adopted in connection with electric traction on suburban lines. Thus, instead of the carriage having only two doors and seating accommodation for 50 or 60 passengers, the same sized car with side doors (even allowing for space cut away between the compartments) could seat from 70 to 80 passengers with from 8 to 10 doors, and with this system of doors it will be found possible to unload and load a crowded train in from 10 to 30 seconds. Although the type of coach employed on the District has been called American type, all Americans do not necessarily agree with it; the progressive Illinois Central Railroad has adopted side doors for its suburban coaches, and they have proved remarkably successful.

Such side doors could, if required, be opened and closed by pneumatic pressure, but such operation would not appear to be a necessity. With the use of single-phase traction and the peculiar characteristics of this type of motor, there appears no reason why the method adopted at present for opening and closing doors on our railways should not be continued when electric traction takes the place of steam. If this were so, each train, supposing that it was not of great length, would be operated by one driver and a guard, instead of by a driver, stoker and guard, as at present in steam practice, or by a number of guards equal to one less than the number of coaches and a driver, as on the District.

The fact that the whole system is at present incomplete, as well as the insufficiency of the data at present available, cannot enable anyone to declare authoritatively that the Metropolitan District electrification has been a failure. Their position would certainly not have been better than at present had they retained steam operation.

No results, or want of results, on their lines in any way affect the fact, that railway companies who are not prepared practically entirely to give up their suburban service, have no other alternative than to electrify.

Westhoughton Electricity Supply.—The U.D.C. has decided to oppose the application of the Lancashire Electric Power Co. for a prov. order for E.L.

ELECTRIC GOLD DREDGING.

THE Conrey Placer Mining Co., at Ruby, Montana, have three gold dredges operating in the fault at the mouth of Alder Gulch, Madison County, Montana. This Gulch is an historic one by reason of the large amount of gold extracted from it by the pioneers in the "sixties" and later. Two of these dredges are operated by steam, one being started in 1899, the other in 1902.

Since the latter date, greater attention has been given to the perfecting and cheapening of operating methods. In California it is the general practice to use electric power, but this has been slow of adoption on the Conrey property, owing, among other things, to the need of artificial heat for operation in the winter months in such a severe climate. It was decided, however, to equip a dredge with electric machinery, using a supplemental steam heating system for the colder months.

This dredge is of the single-lift, sluice-box type; it was built entirely from designs made by the owners. The hull is 130 ft. long × 48 ft. wide, giving it probably a greater area than any other dredge of its kind ever built. It is 8 ft. deep, and thoroughly trussed for all the known strains. The ladder-way, or well, in the centre of the forward part, in which the bucket chain and ladder work up and down, is 64 ft. 9 in. × 7 ft. 3 in.

The ladder is 100 ft. from centre to centre of tumblers, and the bucket chain is of the open-connected type at present, with 41 buckets and 41 space links. The bucket complete, with manganese lip and sheet-steel hood, weighs 2,600 lb., and the space link about 1,400 lb.

Both upper and lower tumblers are six-sided, fitted with manganese wear-plates, and bearing on 16 in. × 13 in. nickel-steel shafts. On the ladder are 12 steel rollers, 12½ in. in diameter.

The material excavated is elevated over the upper tumbler, and dropped on to a steel dump sheet, where it enters a revolving screen, 18 ft. long by 5 ft. dia., which allows the fine material to pass into a series of sluice boxes in which the gold, in flakey and floury form, is caught by the use of freely sprinkled quicksilver. A shaft on one side carries a gear through which the screen is driven by a 10-H.P. type "F" Westinghouse induction motor.

The sluice on the upper deck is 28 ft. 10 in. long, lined with Hungarian riffles. The long sluice on a separate pontoon is 135 ft. long, also lined with similar riffles. Near the lower end is a set of closely spaced bars, with an opening in the bottom of the sluice itself, permitting a portion of the finer material to be carried into an undercurrent or auxiliary sluice, 54 ft. long, and lined with wood riffles of the same type. The joints of the sluice are made with a pure gum packing fitted between specially designed cast rings to prevent leak or spill.

The dredge is swung from side to side in the pond by means of ¾-in. cables, leading out to a shore sheave, whence they return to the dredge and connect to a reversible friction type winch propelled by a 10-H.P. Westinghouse induction motor.

The dredge is held to its work by a system of mooring cables, which are operated by a large 4-drum winch on the lower deck. This winch is equipped with the necessary brakes, friction clutches, &c., weighs about 45 tons in all, and is operated by a 30-H.P. type "F" Westinghouse motor.

When the boat is to be moved ahead after a cut has been taken out, the stern lines are slacked off and the head lines pulled in; the latter also serve to hold the buckets to their work.

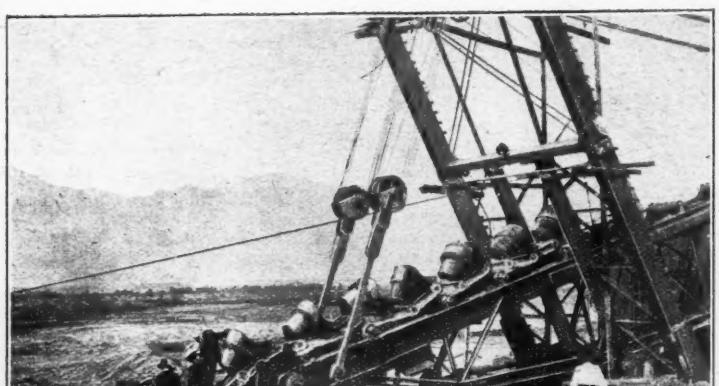
The power for the digging is transmitted through a specially built 150-H.P. type "F" Westinghouse induction motor, capable of 100 per cent. overload. It is set on a structural strut connecting the mooring head with the bearings of the upper tumbler, and is pinioned to a specially designed Miller slipping friction clutch, the 7-in. shaft of which is geared to a 10½-in. shaft, carrying a pinion which meshes into the 13-ft. main driving gear on the tumbler shaft. This large gear weighs 11 tons. There is also provided an auxiliary brake on the friction shaft.

The ladder is suspended by means of two cables, working

through a double tackle and connected to a Marion hoist, propelled by a 75-H.P. type "F" Westinghouse induction motor, equipped with magnetic brake.

To wash the gravel there are one 10-in. Worthington horizontal volute pump, coupled to a 50-H.P. G.E. (U.S.A.) motor; one 12-in. Morris centrifugal pump, coupled to a 50-H.P. type "C" Westinghouse motor; and one 14-in. Worthington horizontal volute pump, coupled to a 75-H.P. G.E. (U.S.A.) motor. The total capacity is about 12,500 gallons per minute.

Three-phase alternating current at 60 cycles is transmitted from the power plant on the Madison River, 35 miles away, at a pressure of 46,000 volts; this is stepped down to 2,200 volts for use on the dredge. For several of the smaller motors it is then further stepped down to 400 volts, and



Ladder and Buckets of Electric Dredge.

110 volts for the lights. The power is brought to the dredge by means of a heavy insulated cable, 2 in. in diameter, supported across the water on a chain of small pontoons; the latter also serve as a gangway.

In the pilot house are arranged the controllers for the various type "F" motors, in addition to the operating levers, brake wheels, &c. A switchboard is also installed there, consisting of five marble panels, equipped with the necessary volt, ampere, kilowatt, and watt-hour meters, all of Westinghouse make.

The dredge has a capacity of about 100,000 yd. per month, if not more, and operates continuously on the three-shift basis. It commenced digging on September 12th, 1906.

SIDE-STREET LIGHTING.

By A. C. HANSON.

The problem of the lighting of the main thoroughfares is usually solved, except in some of the gas-mad towns, by the adoption of arc lamps; either flame, enclosed or ordinary open type. It must be recognised, however, that arc lamps of any thoroughly satisfactory type form too large units for the lighting of what may be conveniently described as side streets. The lighting of these streets, therefore, is usually effected by gas lamps, either incandescent or "batswing;" though, in a considerable number of towns, electric light in some form or other has been partially adopted.

It will generally be conceded that ordinary carbon filament lamps are not a success for street lighting. The first experiment in electric street lighting (after the main streets had been lighted by arc lamps) in the town of which the electric supply is in my charge, was by the erection of some 10 posts, each carrying two 16-C.P. lamps. These posts replaced "batswing" gas posts, and from a photometric point of view, the result was satisfactory, but as the incandescent gas lamps replaced the flat-flame in the neighbourhood, complaints were heard of the dull electric light, though on windy nights when most of the gas lamps were blown out, and the remainder were scantily clad with half a mantle, I have no doubt the wind-scorning electric lamps were blessed. There is one form of carbon filament lamps that I think might have been adopted to a greater extent than it has been, and that is the reflector glow lamp, made with a reflecting back of parabolic shape, so designed as to throw a beam of light down the footpath. I have some miles of streets lighted by these lamps, and the lighting both of the footpath and of the roadway is sufficient and uniform. Even here, however, the ubiquitous "man in the street," whose method of judging street illumination is by seeing how completely he is dazzled by looking at the lamps, soon cries for the white-green glare of the incandescent mantle.

In many towns the Nernst lamp has been largely adopted as a rival of the gas lamps for side street lighting, and there are many points in its favour. With a proper globe, either clear or holophane, it is efficient; the light distribution of the A and A.D. types is good, especially with the holophane globe; and the light is white enough to satisfy the popular demands.

En passant, I should say that both the old type of frosted globe, and the more modern opal glass, are great light absorbers, and should never be used. The frosted globe especially, after a few days' exposure to dust and rain, is enough in itself to damn the Nernst lamps. The extreme unreliability of the Nernst burner, is, however, a strong argument against its use for street lighting; one burner will burn, if it is allowed, for 1,000 hours, the next two or three may have an average life well under 100 hours.

In Stirling, where I have about a hundred of this type of lamp in the streets, I have tried replacing all burners after a certain fixed life, say, 600 hours, but the large proportion that give out before this life has been attained reduces the average life to an absurdly low figure; therefore I have gone back to the system of letting each burner live its own life—with a maximum of 1,000 hours—and the results are somewhat better from the point of view of economy. When this system is adopted, however, one has to face the very unpleasant fact that each lamp will be out one night in every few weeks during the dark season; and if two or three adjacent lamps take it into their heads to die on the same night, the lighting of the street on that night will hardly prove a good advertisement for electric street lighting.

The tantalum lamp, the only form of metallic filament lamp freely obtainable as yet in this country, is the one which, to my mind, is best suited for the electric lighting of side streets; the locus of the light is large, the distribution good, the colour right, and the efficiency fairly high. I find that two 115-volt tantalum lamps taking about ·36 ampere give a better lighting effect than a ½-ampere Nernst lamp. By this I do not mean to assert that absolutely more light is obtained from the tantalum than from the Nernst lamp, but that the lighting effect is better. The life of these lamps is also more uniform; only a small proportion expire under 500 hours, in fact, quite as many last over 800 hours.

By fixing the maximum life at, say, 650 hours, one is rarely shocked by the sight of a "dead 'un." One important point—don't over-run tantalum lamps. A network near a feeding point is always carrying more than the declared pressure; in such cases it pays to keep two voltages in lamps, say, 120 and 115, and arrange the lamps according to the real pressure at which they run. It is easy to keep districts separate, and with a little care, no confusion should occur; while the effect in the increase of life is marked, and the effect in decrease of light is not. Assuming that tantalum lamps have been chosen for side-street lighting, the next question is, how are they to be connected to the mains? Undoubtedly the best method is to run a special main for street lighting, and where public lighting goes before the

ordinary supply, this method will be adopted as a matter of course. In the majority of towns, however, the streets were fairly well cabled before side street lighting was thought of; and in such cases the extra expense of a separate main might turn the scale in favour of incandescent gas.

It must be remembered that to get the full benefit of separate circuits for street lighting, the system must be carried throughout; little saving in wages, &c., is effected by having a few streets lighted from separate circuits, while the remainder are lighted by lamps connected to the distributor. In most small towns the engineer will not be able to obtain a lamp district at one "fell swoop," he will have to content himself with the conversion of two or three lamps here and two or three lamps there, till finally the whole district is electrically lighted. In such cases one is driven to connect the lamps direct to the ordinary supply, and if the work is done in a proper manner very little trouble will be experienced. A cheap, and, I believe, a usual method is to run lead-covered rubber wire from the distributor joint box up to the switch and fuse box at the top of the post. If two points are carefully watched, this will make a satisfactory job, although I have now discarded lead-covered wire for this work. The two points are, first, the wires must be properly sealed at the fusebox, and second, the lead covering must be thoroughly protected from mechanical and chemical action on its way from the joint box to the lamp base. The protection of the lead covering may either be given by running the wire solid in wooden troughing, or, as I found to be cheaper, more convenient, and probably as efficient, by drawing the wire into circular loom. It is not easy to get a completely satisfactory seal in the fuse and switch box, as the space is small, few boxes are properly designed, and the extremes of heat and cold are very trying. It is worth while spending time and money on this detail, as the life of the service depends on it. The method I have now adopted is to run two 7/23 specially taped wires in two lengths of circular loom from the joint box to the switch. Up to the present I have had no trouble with any of the services run in this way.

The switch I use is a double-pole switch with a double-pole fuse attached to the switch block, which latter is removable for fuse renewals. It is most important to have a very strong switch, as lamp-lighters are by no means gentle in their methods. In the earlier forms of switch, it was no uncommon occurrence for the switch handle to be twisted off the spindle. The insulation of the switch and fuse should be of the best, as the apparatus is exposed to all the samples of weather for which this island is famous.

A small detail which is apt to be overlooked is that of the advisability of having an insulator between the lampholder and the switch box. A breakdown of the insulation of a lampholder is not infrequent, and should not be allowed to earth the post. If an insulating nipple is placed between the lampholders and the extension piece from the switch, an earthed lampholder is of small importance.

The question of costs does not come within the scope of these notes, and I can only say that I can compete with equivalent gas lighting on this point, and give in addition the advantages inseparable from electric lighting.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Economy of Electrical Winding Plants.

I note that you have been kind enough to refer in your issue of December 28th, 1906, to the paper which I read in Manchester, and before the Institution of Electrical Engineers, in London.

I am quite sure that your readers will give me credit, along with Mr. Hooghwinkel, for wishing success to the application of electricity to winding, and I should like it to be clearly understood that I am not, as some people have been good enough to state, an opponent to electric winding, and I only read my paper with the object of bringing forward as clearly as I possibly could, the existing state of steam winding in this country, and the possibilities of electric winding for heavy duties.

It is, of course, very difficult to assume a standpoint which will meet every condition of working, and in the figures which I prepared in connection with my paper on the cost of electric winding plant, I took my generating plant of such a size as would be required supposing the set were to be used for winding only, and I quite agree that with larger units there will be a saving in the cost of the generating machinery. At the same time it must be borne in mind that I did not provide for any spare machinery.

I have already stated that I do not consider that the mere statement that the consumption of steam per effective horse-power on the rope is less, has any great bearing upon the ultimate cost of the winding, because one has to take into account not only the mere coal consumption, but the difference in first cost of the steam or electric winder, the large amount for interest and depreciation which this involves, and the amount of attendance involved in the two cases.

Dealing, however, with the question of steam consumption per effective horse-power, I am sorry that I cannot accept the statement in your issue of the 28th ult., in which it is stated: "Considering a steam winding plant of the most modern design, the steam consumption per effective horse-power-hour on the rope may be taken as 44½ lb., over the whole 24 hours' run, including all stoppages. This is a lower figure than has actually been hitherto attained, but should be attainable with the latest improvements in the steam-driven machinery." This you quote from the *Elektrotechnische Zeitschrift*.

The writer of this article is apparently not versed in the results which have been obtained from modern steam winding engines, and I think it would be of interest to your readers to have the actual figures before them of a test made at the Village Deep Mine, on the Rand, by Messrs. Laschinger, Robeson & Behr, the particulars being as follows:—

Diameter of high-pressure cylinders	17 in.
Diameter of low-pressure cylinders	28 in.
Length of stroke	60 in.
Type of winding engine	Coupled compound tandem
Duration of test	7 hr. 5 min.
Total ore hoisted	1,542,213 lb.
Depth hoisted from (vertical)	2,290 ft.
Total indicated work in cylinders in ft.-lb.	4,145,821,180
Total steam consumption	45,579 lb.
Average initial steam pressure (absolute)	132·30 lb. sq. in.
Average final steam pressure (absolute)	2·01 lb. sq. in.
Average moisture in steam supplied	0·565 per cent.

PRINCIPAL RESULTS.

Average shaft horse-power	251·812 H.P.
Average indicated horse-power	295·602 H.P.
Average steam consumption (per hour)	6,434·682 lb.
Average steam consumption per shaft H.P.-hour	25 5535 lb.
Average steam consumption per I.H.P.-hour	21·768 lb.
Mechanical efficiency of hoisting apparatus	85·186 %

It may be argued that this test is only over a period of 7 hours 5 minutes, but a further test with the same plant was made by Mr. Atkinson, over the full day of 24 hours, the result being that the steam consumption per shaft horse-power was 32·3 lb., and during the period in which this test was made, the actual winding time was only 45 per cent. of the total time. This shows that the stand-by losses are nothing like as much as claimed by some of the advocates of electric winding.

It is rather interesting to note that this figure compares very closely with the figures given as the consumption at Zollern II over a 24-hour day, namely, 31·5 lb.

These results are also borne out by the tests which have recently been made on the compound steam winder at the Sherwood Collieries, and I hope to be able to give some details of these tests at an early date.

There is no question that a motor-generator—with a heavy fly-wheel or an equivalent arrangement—is absolutely necessary if a high efficiency is to be obtained, but it must be remembered that this piece of machinery is very expensive, and further, that in collieries where the winding is done in eight hours per day, and the winding engine is only required

occasionally during the night—it is usual to keep the motor-generator running, and the loss due to this will far more than equal the loss due to condensation in well covered steam pipes.

Against the advantages of the motor-generator or Ilgner system, it must be remembered that the loss between the horse-power of the engine driving the generator and the actual horse-power transmitted by the winding motors to the drums, is something like 45 per cent.

To prove that the actual consumption of steam per useful horse-power is not the only point to consider, it may be interesting to refer to the figures which I gave in connection with some of the steam winding plants, as under :—

Name of Colliery.	Shaft depth.	Tons wound per day.	Steam consumption per useful H.P.	Value of coal per ton used.	Cost per 100 tons of coal wound.
Bolsover	373 yds.	2,000	129 lb.	2s. 6d.	5s. 3½d.
Denaby & Cadeby	763 yds.	3,360	83 lb.	1s. 6d.	5s. 2d.
H. Rhodes (Rotherham)	550 yds.	3,186	48 lb.	3s. 0d.	3s. 11d.
Hickleton Main ...	542 yds.	2,900	88 lb.	3s. 6d.	6s. 10d.

These results are obtained from plain winding engines without any great attempt at economy, and it becomes a great question (where the value of the coal used under the boilers is small) whether there is any advantage in spending a large sum of money on very economical and more expensive winding engines.

I further note that you refer to winding speeds being increased from 20 to 32 ft. per second. I am aware that this slow speed of winding is common on the Continent, but in this country the speed of winding is generally from 60 to 70 ft. per second, and sometimes faster, and the designers of electric winding machinery for modern pits in this country must be prepared to supply winding plants to deal, not with the small outputs mentioned by most of the speakers who discussed my paper, but with outputs of not less than 2,500 tons to 3,000 tons in eight hours, from depths of 500 to 700 yds.

I must confess that I was pleased at the amount of discussion which arose upon my paper, but greatly disappointed that not a single figure was brought forward by anyone as to the actual cost of the winding plants on the Continent, or any figures obtained from actual working results, and I think it would be very helpful to the electrical profession, and also to colliery owners, if the actual costs of some of the large winding gears were given—including the proportion of the cost of generating machinery — and the results reduced to the actual cost of winding 100 tons of coal. I am aware that the depth has to be taken into account, but this can easily be considered.

In conclusion, I would like to try and remove the impression that I am an opponent to electric winding. I am satisfied—as I have already stated—that there is a very large field for electric winding in suitable positions, but I do think in trying to compete against steam winding with high class engines, for heavy outputs, that we have a very severe task before us, and it can only be done by a very great reduction in the cost of the electric winding machinery, which—as far as I can see at present—is hardly possible.

W. C. Mountain.

Gateshead-upon-Tyne, *January 8th*, 1907.

Turbo-Generator Tests.

Referring to the paragraph which appeared in your issue of November 30th, and to Mr. Conover's letter to you of the 28th ult. relative to the above, I should like to confirm the views of the B.T.-H. Co. as to the temperature rise of turbo-alternators.

The experience of the Brown, Boveri Co. with close upon one million H.P. of turbo-generators to its credit shows conclusively that such machines (whether A.C. or D.C.) can be built to conform to any reasonable requirements in respect to technical performance, and this exceptional experience would permit that company to guarantee under the most stringent conditions a temperature rise of 70° F., if such was called for, without sacrificing the other desirable qualities of the machine. This not only applies to machines of a thousand or so kilowatts output, but to the largest size standardised by us—for instance, to 10,000 or 12,000-KW. alternators.

Whether such low temperature rises are really necessary is another question altogether, and one that has been answered in the negative by Continental users : doubtless before long our own Engineering Standards Committee will also make a pronouncement on the subject.

As a matter of fact, the great point in respect to the temperature rise of turbo-generators is not that this should be as low as possible when measured on more or less accessible external parts, but that the temperature rise should be as uniform as possible throughout the machine, no internal part being much warmer than the accessible portions. Both electrically and mechanically, excessive temperature differences are very undesirable—much more so than in any other class of electrical machinery—but a great number of people continually overlook the fact, and as long as they can get a 70° F. rise with a thermometer applied to an accessible part, are indifferent to what the actual temperature inside the cores or the coils may be.

I do not think it is too much to say that during the next few years some marked changes will be seen in respect to the present ventilating arrangements of most turbo-alternators made in this country.

A. C. Eborall.

Westminster, *January 8th*, 1907.

Tramway Lifeguards.

I have just had a curious case of a small child, 2½ years old, falling in front of a car and operating the lifeguard. Our lifeguard hanging gates are fitted with two wooden longitudinal strips spaced 2 in. apart, and in the case referred to above, the foot of the child passed between the wooden strips and got jammed there.

Fortunately, owing to the promptness of the motorman, the car was pulled up almost at once, and the child received no injury. There was a good deal of difficulty, however, in extricating its foot from between the strips.

I have just measured some cars of quite recent make, fitted with a similar type of lifeguard, and these wooden strips are spaced 2½ in. apart.

I should be glad to hear if any other managers have met with a similar occurrence to the above, and if so, whether they have taken steps to reduce the distance between the strips in consequence. The contingency of the above happening where very small children are concerned is always present, and it would seem desirable in all new lifeguards, and also when repairing old ones, to reduce this distance, say, to 1½ in., which would probably be perfectly safe.

On consideration it would seem that there is an even greater risk of the foot or leg being trapped owing to the considerable space there is above the two strips of the hanging-gate and the underside of the car platform, amounting to 10 in. or more.

There is always a likelihood of a person being caught by the hanging-gate with his legs turned towards the car and raised some distance from the ground, so this would seem to constitute a danger to both childen and adults. The fitting of a third or even fourth strip would, I think, remove this possible danger.

P. J. Pringle.

Burton-on-Trent, *January 12th*, 1907.

Metallic Filament Lamps.

May I be allowed to add my testimony in favour of tantalum lamps. Eighteen months ago we installed the first pair in a street lamp ; this pair has now been burning nearly 3,000 hours, and is still giving a better light than two new 16-C.P. carbon filament lamps installed in an adjacent lamp-post. Some time during this past 18 months the filament of one of the lamps broke, but must have immediately anchored across another filament, as the street lighting reports do not contain any reference to this lamp having been reported "out." We have within the last three months fitted some 20 of our street lamps with tantalum lamps, and so far not a single filament has failed ; and we have now on

order a sufficient number of tantalum lamps to change over the remaining 200 street lamps in which carbon filament lamps are still installed.

Our private consumers have already realised the benefit of these lamps, and the local wiring contractors, I am sorry to say, are unable to obtain lamps fast enough to meet the demand. Several of our customers have already reduced their bills by 30 per cent., at the same time obtaining a better light, and while such reductions as this may adversely affect the income of supply stations at first, I feel sure that we shall more than make up for this later on by the great help that this type of lamp will give us in fighting incandescent gas.

John B. Morgan,
Electrical Engineer.

U.D.C. Electricity Works, Horsham,
January 12th, 1907.

In the course of the discussion last Thursday in connection with Mr. Swinburne's paper, Prof. Silvanus P. Thompson stated that he had installed in his house six tantalum lamps last August, and that only two were still burning. It would have been fairer if the Professor had added that he is now supplied with alternating current by the Hampstead Borough Council (who took over the consumers of the Hampstead Battery Co.). It can surely not have escaped his notice that the makers have extensively advertised the fact that tantalum lamps are not reliable when used on alternating-current circuits.

'Appy 'Ampstead.

Wireless Telegraphy and the Admiralty Contract.

We now know precisely what is the value of Mr. Cuthbert Hall's statements. They stand—or rather fall—upon nothing more than his own unsupported *ipse dixit*. The oracle has spoken: it cannot be contradicted. Mr. Cuthbert Hall is infallible; his denial outweighs all the evidence, even the production of the official documents themselves. The Admiralty officials are obvious fools to think that their contract means what it says—for Mr. Cuthbert Hall declares it does not, and his word must be taken as final. It is simply gorgeous.

Now, I made the statement, the deliberate and considered statement that, under its contract with the Marconi Co., the Admiralty is not compelled to purchase from that company any other apparatus "except jiggers and trays of Leyden jars." Mr. Cuthbert Hall rushed into print to deny the statement, but he has given no authority or reference in support of his denial. My reply was definite and complete: I gave the reference to the contract which any person can obtain for a penny from H.M. Stationery Office, and in which there is printed a schedule of such apparatus as the Admiralty is under that contract still compelled to purchase—if it purchases any more—from the Marconi Co. The schedule contains a list of four particular types of jiggers, and two particular arrangements of Leyden jars, nothing more. Yes; jiggers and jars. I challenged Mr. Cuthbert Hall to say whether any other apparatus was scheduled. He does not—because he cannot—mention any other apparatus that is so scheduled; and his denials have no force, they are sheer empty words, lacking the solidity even of a coherer.

The officials of the Admiralty are not fools: the public are not fools. The Admiralty does not draw up lists of things which it is compelled still to buy from the Marconi Co., and put them down solemnly in a special schedule, in order to blind the public, or for fun, or merely to oblige Mr. Cuthbert Hall. Jiggers and jars are the only things listed in the Admiralty schedule of things it still is not free to buy elsewhere. Any other apparatus covered by the contract, and not inserted in the schedule, is outside the limitations attaching to the things that are in the schedule, namely, jiggers and jars. To secure, amongst other things, this right of freedom from being bound to buy other apparatus (except jiggers and jars) from the company, the Admiralty paid a large sum. Twenty thousand pounds may not have been an excessive price: but it was paid by the nation. And now without a scintilla of evidence, on his own bare and unsupported denial, Mr. Cuthbert Hall has the hardihood to argue that the Admiralty has not got the freedom of purchase so dearly bought! It is high time that the attention of the Admiralty board was directed to this repudiation by the managing director of the Marconi Co. of the provisions so carefully laid down. The clauses of the published contract are perfectly clear. The Admiralty has contracted to obtain freedom of purchase, save with respect to certain scheduled articles. It paid the Marconi Co. large sums for that contract and to secure that freedom. The only articles scheduled are jiggers and trays of Leyden jars. Even the prices are agreed: jiggers from 10s. 9d. up to £1 1s. 6d. each; Leyden jars from 19s. 8d. to £1 0s. 8d. apiece (trays included). If Mr. Cuthbert Hall pleases to write 50 more denials, he will not thereby put into the schedule any other articles, because they are not there now. How sorry he must be that he did not include relays, masts, coherers, and a few other details. Jiggers and jars: jiggers and jars. Ha! ha!

Your Correspondent.

Street Lighting.

At the time of the lighting of Kingsway and Aldwych I noticed an article in a daily paper giving full particulars of the lighting of this street. It finished up with a sentence to this effect: "When the lighting is completed Kingsway will be the best lighted street in London." At present Kingsway and Aldwych cannot be called well lighted. The high-pressure lamps, though fairly good ones, are not nearly powerful enough to efficiently light this wide thoroughfare, and a great mistake was made in trying to light the new street with gas.

Oxford Street, with its new flame arc lamps, is a magnificent sight, and is undoubtedly the best lighted street in England, if not in Europe. The standards are extremely graceful, and the Marylebone Council are to be commended for the brilliant lighting of this handsome thoroughfare. How different the effect would have been had the gas company got the contract—long rows of ugly gas standards, their sickly green rays making people look like corpses, and what light there was wasted on the gutters!

Old Reader.

Publicity Methods.

I am very pleased to note from your leader in the current issue that you intend to pursue the above subject further, as in these times of strenuous opposition on the part of gas undertakers it is essential that electricity undertakings should retaliate in similar fashion.

I believe it is generally conceded that local electrical exhibitions have considerable advertising value. Those, however, who have ever organised such an exhibition know the amount of trouble and expense involved—particularly in the smaller towns, where manufacturers of electrical apparatus, &c., do not seem inclined to render as much assistance as in the case of larger towns and cities.

It has occurred to me that if a firm—possibly advertising agents—would organise an exhibition on a portable scale; their show could be booked to tour from town to town in a similar manner to theatrical companies; they could be paid so much a week for their services, or in the case of the more avaricious authorities who make a charge to the public for admission, they could be paid the takings, plus a fee. In this way the very best exhibition would be obtained, and also the experienced staff would be possibly better and more convincing exponents than the local engineering staff.

I am aware that a similar travelling exhibition was organised by Messrs. Edmundson some time ago, and I believe the results were eminently satisfactory, but the services were, of course, confined to the various undertakings controlled by that firm only.

I feel sure that such an organisation would be most effective both to promoters and clients. Of course, the difficulty of different pressures, continuous and alternating current, &c., found in different towns would crop up, but apparatus could be specially designed so that the insertion of a little resistance, or in one or two cases the substitution of alternating for direct current apparatus, would easily overcome that.

Wm. J. U. Sowter.

Electricity Works, Bray.
January 14th, 1907.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New Electric Light Fittings.

On the occasion of a recent call at the works of MESSRS. H. W. SAMBIDGE & SON, LTD. (Birmingham Chandelier and Gas Fittings Works, Highgate Street, Birmingham) we had an opportunity of seeing a variety of examples of the firm's high-class products in art-metal work possessing marked originality of design. This quality was particularly noticeable in their electric light fittings. The firm have now issued a small pamphlet illustrating a number of new designs of Flemish designs. From these we select a couple. Fig. 2

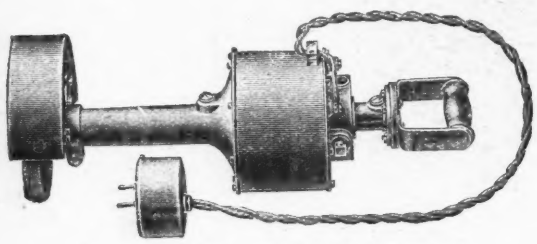


FIG. 5.—"LITTLE HUSTLER" HAND GRINDER.

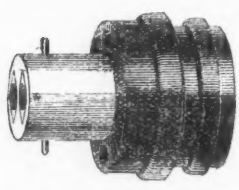


FIG. 3.—PLUG LAMPHOLDER ADAPTER.

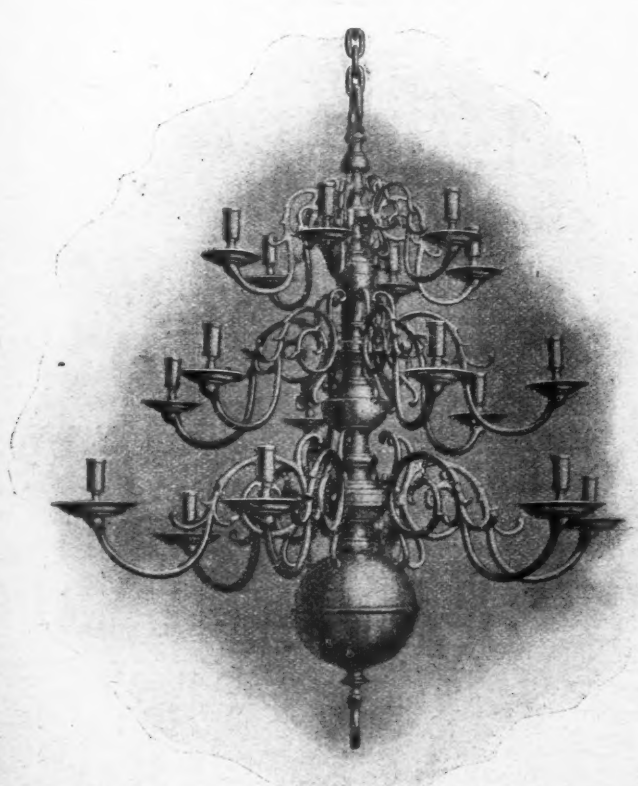


FIG. 1.—A SAMBIDGE FLEMISH PENDANT FITTING.

represents a four-light bracket and pendant combined, and fig. 1 is an elaborate Flemish pendant, such as they supply for 6, 8, 12 or 18 lights, with a spread of 32 in. In this small booklet there will also be found bracket and standard fittings in similar style. These fittings have hollow arms, so that all the wiring is unseen. They are fitted with "Huntalite" candles which give a very pleasing appearance and effect. The patterns illustrated are strictly correct models in every detail.

"Little-Hustler" Electric Tools.

The ARMORDUCT MANUFACTURING CO., LTD., of Farringdon Avenue, E.C., are just issuing a new list (L.H. 753), in which their auxiliary machine tools, known as the "Little Hustlers," are described. In fig. 3 we show a plug lampholder adaptor which has considerably advanced the adaptability of these tools.

The variable speed breast drills were introduced by the company some two years ago, and they are now doing service in many large shipbuilding yards and engineering works at home and in the Colonies. The sensitive bench drill is shown in fig. 4, and it will be seen that, as in the case of the breast drill, the current is supplied to the machine by a flexible cord connection, which is attachable to any ordinary lamp-holder or plug. The drill is attached adjustable in a vertical direction to the supports; this adjustment is simple, and admits of the removal of the drill at any desired time, and the drill can be readily converted into a breast drill by means of the necessary attachment. This circular also contains particulars of "Little Hustler" hand-grinders for direct and three-phase current—which are intended for grinding or buffing heavy work, which it is impossible to bring to a stationary tool. They are claimed to be particularly useful for heavy castings and bulky articles which, where a tool of this

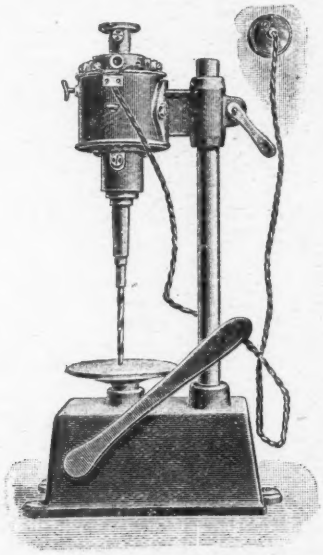


FIG. 4.—"LITTLE HUSTLER" BENCH DRILL.

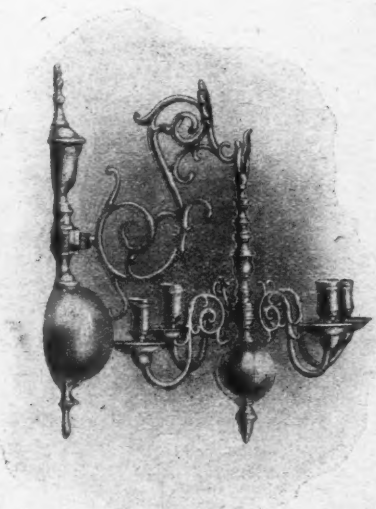


FIG. 2.—COMBINED BRACKET AND PENDANT.

description is not available, have to be hand-worked at very considerable expense. The motor is actuated by a switch in a similar manner to that used in the case of breast drills. A strong handle is attached to the head of the machine, and the neck supplies the second hold. The operator is protected from the emery, or buffer wheel, by a shield. A patent automatic overload cut-out is attached to all direct-current machines.

The hand and bench grinders are shown in figs. 5 and 6. In the

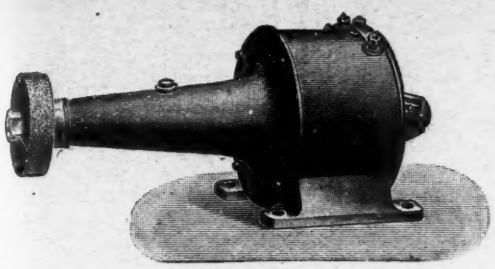


Fig. 6.—"Little-Hustler" Bench Grinder.

circular already referred to there will be found a table of prices, weights and dimensions, also diagrams showing the construction of the tools.

Cable Troughing.

Mr. G. Braulik, of Upper Thames Street, E.C., is putting upon the market a patent system of cable troughing for application in the laying of electric cables. The troughing is made of hot-rolled iron, tarred inside and outside. It consists of two halves—top and bottom—each being semi-circular in shape, and fastened

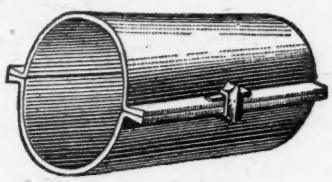


Fig. 7.—Cable Troughing.

together by means of clamps and cotters. The various pieces are placed lengthwise over each other in such a way that a top half overlaps two bottom halves, and *vice versâ*, thus forming half joints occurring above and below. This troughing is made the subject of some circulars that have just been published by Mr. Braulik, wherein the various advantages which are claimed for it for protection of cables from outside influences, such as pick-axe blows, and from the effects of cement upon lead, and in various other ways, are dwelt upon at some length. It is also suggested that the troughing

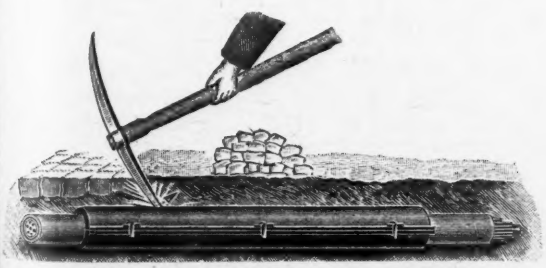


Fig. 8.—Cable Troughing as Laid.

in its half form is well adapted for protecting cable laid in private grounds, along railway tracks, &c. In figs. 7 and 8 the system is made sufficiently clear without any further textual explanation. In the list before us prices are given for different sizes of troughing and connections, also for cutting machines for oblique or vertical cutting, and a special key for fastening clamps and cotters.

LEGAL.

West *v.* Bristol Tramways and Carriage Co., Ltd.

A novel case involving the question of the effect of creosote on plant life concluded on Friday in Bristol County Court, after a two days' hearing before Mr. E. J. Castle, K.C., and a special jury. The plaintiff was Mr. Henry West, nurseryman, of Cheltenham Road, and the defendants were the Bristol Tramways Co., Ltd.

Mr. Inskip, for the plaintiff, stated that in May, 1906, the Bristol Tramways Co. laid the road between the tramlines with wood. At the same time Mr. West proceeded to lay out his garden in order that he might have stock for his customers, the front of his grounds being much exposed. Seventy or eighty trams passed every hour. During May and June Mr. West noticed while he was bedding out his plants that they withered and died in a way that was very mysterious to him. They did not wither from the roots upwards, as was generally the case when plants decayed, but from the leaves downwards. Plaintiff became satisfied from inquiries that the damage caused to his plants was due to the creosote in which the wood tramway blocks were steeped for the purpose of preventing decay. The gardens of five or six other persons were similarly affected.

Mr. Vachell, for the Bristol Tramway Co., said as far as he knew, and as far as those who were with him in that case knew, that was the first time in any Court of law that these creosote blocks had been impeached. The company had not subjected the blocks in Cheltenham Road to a larger dose of creosote than was ordinarily used in Bristol or in other parts of the kingdom.

The Judge said he should tell the jury that if they found that for ten years the road had been paved with creosote without damaging the neighbouring gardens, and this particular year that damage had arisen, they might draw the conclusion that an unreasonable amount of creosote had been used.

Among the witnesses for the defence was Mr. G. T. C. Edwards, resident engineer to the Bristol Tramway Co., who said creosote beech blocks had been used in his 16 years' experience in Bristol for making up tramway tracks. He had never heard of their injuring plant life before. The blocks in Cheltenham Road were impregnated with eight pounds of creosote to the cubic foot.

Mr. William Weaver, formerly engineer to the borough of Kensington, said he had had laid a million square yards of this class of paving. He had never heard of a claim for damage to vegetation.

Similar evidence was given by Mr. John McGregor, superintendent of the Improved Wood Co., London.

Mr. F. W. Stoddart, analyst, said he had subjected the creosote used in these works to a gradually rising temperature. The mischief complained of could not have been caused by vapour from the creosote. Creosote was used as a dust preventative. The condition of the leaves taken from plaintiff's garden was inconsistent with damage by fumes, and he did not believe the dust theory, as the effect would have been general over the leaves, instead of partial.

The jury, after a long consultation, were unable to agree, and the Judge discharged them.

City of London Electric Lighting Co., Ltd., *v.* Willington

In the City of London Court on Friday last, before his Honour Judge Rentoul, K.C., an action was brought by plaintiffs against Mr. J. Willington, 15, America Square, to recover payment for energy supplied and meter rent charges.

The Defendant said he entered into an agreement with plaintiffs, by which they were to supply him with electric current for lighting purposes. First of all they wanted to impose upon him the payment of a fee of £3 by way of a deposit, which he declined to pay, pointing out as he did so that the gas companies did not make such a charge. Under the circumstances the plaintiff company said they would put on the electric light without insisting upon the deposit. After he had gone to the expense of £12 for electric light fittings they cut the electric current off, and he was very much annoyed. The agreement under which the current was supplied was sent to him, and he had struck out the £3. The plaintiffs had accepted the position.

Mr. H. Bacon, who appeared for the plaintiffs, said the plaintiff company was very surprised to find that the £3 had been struck out, and he could quote from the statute under which they worked. They connected the defendant on January 18th last year, and when the defendant refused to pay the deposit they cut off the supply. They were now suing the defendant for expenses in connecting and disconnecting the current supply.

The Defendant added that the plaintiff company told him distinctly that they would waive the £3. He refused to pay the deposit on principle, and he told the company that it was evidently a practice of theirs, and that it ought to be known throughout the City of London. He told the company in plain terms that he did not intend to finance their concern.

Mr. Bacon said the statute clearly gave them power to demand a deposit where they thought it necessary, and they did think it necessary in the defendant's case.

Judge Rentoul, K.C., said he could quite understand a deposit being insisted upon by the company, and, indeed, there was nothing unreasonable in it.

Mr. Bacon said it was quite true in some cases they did not insist upon having a deposit. There was no truth in the suggestion that they had agreed to waive the deposit, and as soon as they knew the defendant would not pay they cut off the connection.

The Defendant: Why, you tried to get £3 first of all out of me and I said it was nonsense.

After further discussion, Judge Rentoul said he would give judgment for the plaintiffs for 19s. 2d. with costs.

Mr. Bacon said they would not ask for their expenses.

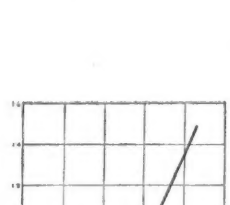
Thermit Welding.—Messrs. Thermit, Ltd., have obtained an order from the Wallasey U.D.C. for the welding of a small tramway extension which the Council is carrying out; also the contract for the welding in connection with the reconstruction of the Birchfield Road Tramways, Handsworth.

BUSINESS NOTES.

Lamp Tests: Gas and Electric Lighting.—We are informed that the Westminster Electrical Testing Laboratory, of York Mansion, Westminster, has just completed a series of candle-power, consumption and life tests on the principal makes of gas burners and electric lamps, showing the relative merits of different makes of lamp, whether gas or electric, and serving as a true basis for the calculation of the respective costs of gas and electric lighting. The results of the tests have been printed in three volumes, either of which can be supplied to subscribers at a charge of 21s. each volume. We are informed that the lamps were all run for a period of 500 hours, with the exception of the Osram and Tantalum lamps, which were carried on to 1,000 hours, and were tested for candle-power at start and afterwards every 100 hours. The reports include the figures for every individual lamp at each period, the average of all lamps or mantles of each make at each period, and tables showing the average of all lamps of each make, throughout their 500 or 1,000 hours' run.

A Long-Distance Trial of an Electrical Motor Vehicle.—The Electromobile Co., Ltd., is in negotiation with the Automobile Club of Great Britain and Ireland with regard to a trial under the supervision of this body of one of the company's electrical motor carriages under ordinary everyday running conditions and over a distance of 6,000 miles.

"Stalloy"—a New Steel Alloy.—MESSRS. JOSEPH SANKEY & SONS, LTD., of 88, Bishopsgate Street Within, E.C., have sent us particulars of the new patented alloy which they are introducing for use in electrical apparatus; in this alloy—known as "Stalloy"—the hysteresis and eddy-current losses have been reduced far below those of the best brands hitherto obtainable. As will be gathered from the accompanying figures, even Messrs. Sankey's own special brand "Lohys" has been left far in the rear. Diagram No. 1 shows the average total loss in sheets of 0·014 in. thickness (about No. 28 S.W.G.) at 50 cycles and various magnetic densities. The improvement is still more apparent in the case of thicker sheets, as will be seen from diagram No. 2, which shows the losses in sheets of various thicknesses at 10,000 B., 50 cycles. The hysteresis loss of "Stalloy" is only 0·2 watt per lb. at B = 4,000 and 100 cycles, whereas with "Lohys" it is 0·4 watt. With "Stalloy" thicker sheets may be used, and, therefore, handling and stamping may be reduced, and less space wasted with insulating material. In designing electrical machinery the special qualities of "Stalloy" may obviously be taken advantage of in reduction of size, increase of output, improvement in efficiency, or lower working temperature. Diagram No. 3 shows the variation of B with H, throughout the usual working range. Mr. Robt. Jenkins is the London representative of the makers, at the address given above.



B.

DIAGRAM 1.

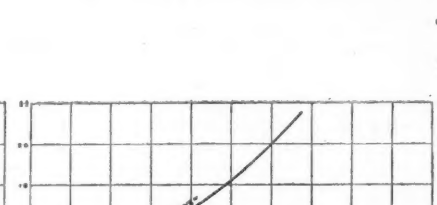
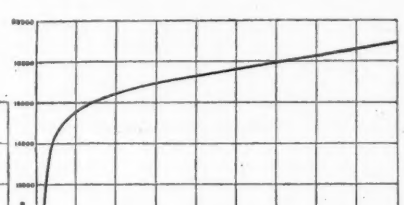


DIAGRAM 2.



H.

DIAGRAM 3.

Anchor Cable Co., Ltd.—At the yearly meeting of the staff of this company, held at Leigh (South Lancashire) last Saturday evening, it was mentioned that last year had been a most successful and prosperous one for the works. Substantial Government contracts, valued at several thousands of pounds, have been carried out at the Leigh works, in addition to the manufacture of lighting and power cables.

Motor Show.—Preparations are well in hand for the automobile display which is to be held at the Agricultural Hall, London, in April next, under the direction of Messrs. Cordingley and Co. The forthcoming event will be the twelfth of the series at the Agricultural Hall.

Boiler House Economy.—The following interesting particulars of the result of a boiler test made at the Swindon Corporation Electricity Works have come to hand. The test was made between a shovel stoker and the Bennis sprinkling stoker and compressed-air furnace. The duration of the test was two hours. Mr. J. G. Griffin, electrical engineer, was present on behalf the Swindon Corporation, and Mr. A. M. Hicks for MESSRS. ED. BENNIS & CO., LTD. The boiler was of the Lancashire type, 8 ft. × 30 ft.; Lydbrook slack coal was used, and the following results were obtained:—

System of firing.	Shovel stoker.	Bennis stoker and compressed air furnace.
Calorific value of coal per lb. as fired	12,168 B.TH.U.	12,436 B.TH.U.
Coal burnt per boiler per hour...	2,156 lb.	1,960 lb.
Coal burnt per sq. ft. grate surface per hour	66·34 lb.	50·26 lb.
Equivalent evaporation per boiler per hour	12,803 lb.	18,095 lb.
Equivalent evaporation per sq. ft heating surface per hour...	12·83 lb.	18·13 lb.
Equivalent evaporation per lb. of coal...	5·94 lb.	9·232 lb.
Total thermal efficiency obtained...	47·14 %	71·71 %
Extra water evaporated as from and at 212° F. per boiler per hour	—	41·32 %
Extra water evaporated as from and at 212° F. per lb. of coal...	—	55·32 %

Consular Notes.— SPAIN.— The Austro-Hungarian Consul at Barcelona, in a recent report, states that the unprecedented extension which has taken place in recent years in electric lighting in Spain has resulted in a largely increased demand for electric lamps, but although these articles are now produced in the country, it is still necessary to import from abroad. In 1905 the imports of incandescent lamps amounted in value to 489,660 pesetas, as compared with 611,756 pesetas in 1904, and 853,384 pesetas in 1903; the imports of arc lamps were valued at 1,572,312 pesetas in 1905, 1,793,472 pesetas in 1904, and 2,138,720 pesetas in 1903. In spite of the decrease which has taken place in the importation of these goods, it is to be noted that the imports from Austria-Hungary in recent years have showed an appreciable increase. The majority of the imports are, however, from Germany.

JAPAN.—The American Consul General at Yokohama, in a recent report, states that with the immense development of electrical enterprises in Japan, the demand for copper wires and cables is increasing daily, and the Furukawa Copper Mining Co. has decided to establish a new factory for the manufacture of copper wires at Nikko, the present factory being found to be inadequate to meet the demand. According to the latest report, the total output of copper wire from their works amounts to 300,000 to 400,000 kin (kin = 1⅓ lb.) per month, which is chiefly supplied to the various cable manufacturing companies of Tokio and Yokohama. The majority of the covered wires used by the department of communication is imported from abroad, and the native manufacturers are said to be contemplating a cable factory on a very extensive scale.

RUSSIA.—In a recent report, the Austro-Hungarian Consul at Kieff states that in spite of unfavourable business conditions which prevailed in 1905, the trade in dynamo machines was very good, owing to the fact that long-projected installations in sugar works, mills, &c, were carried out. The machines were for the most part supplied by German houses which possess branch factories in Russia. Incandescent electric lamps are, as a rule, purchased at the Verkaufstelle der vereinigten Gluhlampenfabriken, in Berlin. Carbons are supplied chiefly by Russian houses, the foreign goods of this class being too dear. Telephone apparatus of the Ericsson system is in demand. Table lights, &c., are imported chiefly from Germany, and house telephone apparatus from Austria. Globes for electric lights find a good demand, and are supplied chiefly from Austria; as the duty on these goods is somewhat high, they should be made as light as possible. Telephone bells, signal wires, cables, &c., are manufactured in Kieff, St. Petersburg, Moscow and Riga.

Book Notices.—*The Japan Year Book, 1906.* Tokyo: The Japan Year Book Office. 7s. net.—This is the second annual issue of this exceedingly interesting volume, which can be obtained from the European agents (the Japan Press, 7, Byward Street, E.C.). A diary of 1905 brings to mind the series of very important events which have so recently occurred in the Far East, and an interesting section is that entitled "Who's who in Japan?" giving brief biographical notes of the more prominent men in the Japanese nation. There are chapters dealing with home and foreign trade, railways, communications, mines and mining, population, local government, geography, education, religions, &c. On page 360 we find a list of the leading electric lighting companies, of which there are altogether 67 with a paid up capital of Y.15,656,130. Electric lighting companies in London in their palmiest days never did so well as these Japanese concerns, some of whose latest dividends are 15, 16, and 20 per cent. The statistics relating to telegraphy and telephony on pages 482-4 show wonderful progress. At the end of 1894 there were only 2,843 telephone subscribers, while at the end of 1904 the total was 35,528. All who have any connection with Japan or Japanese industry, or who wish to know anything more about this remarkable people and its progress, would find this book of great value.

One and All Gardening for 1907 is already so well known that we need only mention that this 200-page twopenny annual has just been issued by the Agricultural and Horticultural Association, of 92, Long Acre, W.C. The publication would be considerably improved if the illustrations were printed.

Willing's Press Guide. London: 125, Strand, W.C.—This simply arranged and useful guide to the Press has with the 1907 edition reached its thirty-fourth annual issue. At one shilling the purchaser certainly gets full value for the money laid out.

Affärsvärlden, 1906.—We have received from the editor of our valued Swedish contemporary, Dr. E. E. Etzel, a copy of the special number of *Affärsvärlden* for 19 6. It is a very remarkable production, comprising 300 pages of editorial matter, to say nothing of numerous pages of advertisements, and dealing with the leading industries of Sweden, her resources, commerce and future prospects. There are, besides, very many articles of general interest, and the whole is profusely illustrated. One section deals with the Swedish tour of British journalists which took place last summer, giving the opinions of a number of them on Swedish industry; these are unanimously couched in tones of admiration and eulogy. Many snapshots of the tour accompany this section, and it is clear that the party had the time of their lives!

"Precision Grinding." By H. Darbyshire. London: A. Constable & Co., Ltd. 1907. 6s. net.

"Electric Railway Engineering." By H. F. Parshall & H. M. Hobart. London: A. Constable & Co., Ltd. 1907. 42s. net.

"Proceedings of the Thirty-Ninth Annual Convention of the American Institute of Architects." 1905-1906. Washington: The Board of Directors, A.I.A.

"The Municipal Engineers' Specification." No. 2., 1906. London: The Proprietors of the *Builders' Journal and Architectural Engineer*. 2s. 6d. net.

"Durch Radium bez. Röntgenstrahlen hervorgerufene Münzabbildungen." By Chr. Jensen. Excerpt from the *Annalen der Physik*. Leipzig: J. A. Barth.

"Proceedings of the Physical Society." Vol. XX, Part III. December, 1906. London: Taylor & Francis.

A Contract Dispute.—Messrs. Leo Sunderland & Co., the contractors for wiring, supplying and erecting electrical fittings at the generating station for the sum of £430, have issued a writ against the Bermondsey Borough Council for the recovery of £189 17s. 9d., and damages for breach of contract. The dispute has arisen on a claim by the contracting firm for the payment of extra expenses incurred, mainly due, as alleged, to the slow progress of the building.

Catalogues and Lists.—CAMBRIDGE SCIENTIFIC INSTRUMENT CO., LTD., Cambridge.—Illustrated Catalogue No. 42 (80 pp.) giving very full descriptive particulars, together with well-executed pictures and information as to prices, of many of their various physical instruments other than electrical instruments and thermometers. We may indicate the scope of the list by stating that the different sections in the catalogue are:—General laboratory, equipment, apparatus for special and angular measurement, recording and time-marking apparatus, mechanics, balances and weights, sound, light, heat and magnetism, seismographs, also examples of special apparatus.

MESSRS. MERRYWEATHER have sent us one of their wall calendars with monthly slips for 1907. There are two interesting views of their fire extinction specialities shown in colours, one representing a steam engine of the Johannesburg Fire Department, and the other a motor fire boat supplied for Venice.

MESSRS. GIBBONS BROS., LTD., Dibdale Works, Dudley.—Illustrated list (8 pp.) showing their various pressed-steel tanks and pipes, pressed-steel tie bars for tramway rails, &c., also conduit troughs for electric cables.

The D.P. BATTERY CO., LTD., have sent us for 1907 a calendar similar to that received last year. It depicts in colours the great wheels at their Lumford Mills, Bakewell, which with supplemental steam plant aggregate 600 H.P. The company's batteries are now being used by over 50 corporations, and most of the leading contractors, as well as for ignition, telephone, telegraph, electric motor-car and other service.

Mr. O. N. BECK, 11, Queen Victoria Street, E.C.—Four-page circular containing an illustrated description of their "Bamag" drill head with three spindles for boring out cored holes, machining the facing, and tapping 1¼-in. gas thread.

MESSRS. SHELBY & CO., LTD., 58, Great Dover Street, E.C.—Circular relating to their "Money-savers for engineers and power-users," illustrating a number of their specialities, including oil-filters and purifiers, steam exhaust head, injectors and ejectors, &c. The firm has lately removed to the address given above.

MESSRS. FREDK. BRABY & CO., LTD., of Eclipse Works, Petershill Road, Glasgow.—A copy of their monthly diary and price list for January, this being a new and enlarged edition. It is of convenient shape and size for the pocket, and we imagine that the general and priced information which it contains concerning the firm's varied manufactures for engineering work is of considerable assistance to their many friends.

MESSRS. H. T. BOOTHROYD, HYSLOP & CO., 64, Leadenhall Street, E.C., and Bootle.—Calendar for 1907, with monthly tear-off slips. Some half-tone views of their manufactures are shown, including a belt-driven generator, electric lift gear, ventilated and enclosed motor, and a type "S" direct-coupled generator.

THE SIMPLIFIED UNDERGROUND CONDUCTOR CO., LTD., of Liverpool, have favoured us and their many other friends with a souvenir in the shape of a small pocket rule, on the back of which is given information which enables one to calculate the quantities and sizes of the different materials which together compose their patent system of underground mains.

New Service and Emergency Brake.—In our report on the last Light Railways and Tramways Exhibition we referred on page 210 of our issue on August 11th, 1905, to the model of a service and emergency brake exhibited by Mr. E. FREUND, of 39, Victoria Street, S.W. This brake has now been installed on a car belonging to the Yorkshire (Woollen District) Electric Tramways Co., whose system contains some of the severest and longest gradients in this country, and only a very small proportion of level track. We are informed that tests were carried out by Mr. E. A. Paris (managing director) and Mr. R. C. Goldston (engineer) of this company, and were partly repeated in the presence of Lieut.-Col. Druitt, of the Board of Trade. They were carried out with three cars of the ordinary double-deck type, having seating accommodation for 43 passengers and weighing about 8 tons. One of the cars was equipped with the new track brake, the other with a modern magnetic brake acting upon tracks and wheels simultaneously, and the third with ordinary hand-wheel and track brakes. We are told that the tests were made in all kinds of weather, and the cars were tried in quick succession. Each experiment was repeated several times, the order of the cars being reversed every time. In this manner every chance of accidental favourable circumstances was excluded. It is stated that the new brake was found to stop the car under all conditions quicker than could be done by one or both of the hand brakes, but stops with the new brake alone were also better than those effected by the magnetic brake, excepting on freshly washed rails, when the magnetic brake gave slightly better results. However, when the new brake was assisted by the hand brake, it is claimed that 25 per cent. better results were obtained, *i.e.*, shorter stopping distances, than with the magnetic brake. The latter was handled by drivers who had been accustomed to it for a considerable time, and skidding occurred only momentarily, showing that the brake was being used to its utmost. The new brake is based on the power storage principle, springs of ample capacity being used for this purpose. The use of the hand-wheel brake for supporting this track brake is facilitated by the way in which the track brake is actuated. For the latter purpose neither the hand nor the foot of the driver is engaged; he merely presses with his body against a horizontal lever, provided at a convenient height, and on the length of time during which this lever is pressed depends the pressure with which the track brake acts. It is claimed that this arrangement has the advantage that the action of the driver always remains the same whether the track brake is to be used for coasting, for a service or for an emergency stop on the level, ascending or going down a gradient, and a mistake is impossible under these conditions. The power is stored when the track brake is wound off. This, it is stated, can be done either by hand or by power, and occupies 2 seconds if the brake has only been acting slightly, and 4 seconds after an emergency stop. Part of this time can be saved by taking up the slack of the pull-off connection directly after the brake is put on. The car has now been in service for some time, and we are told that it is working so satisfactorily that it is contemplated equipping all the other cars with similar brakes. A start is to be made with a car already fitted with the magnetic brake. This is to be altered so that the brake shoes can be worked in a similar way to those above described, but it is intended to use only the lower degrees of magnetisation so as to avoid any danger of the wheels skidding.

Dissolutions and Liquidations.—MEVAGISSEY ELECTRIC LIGHTING CO., LTD.—This company is winding up voluntarily (for purposes of reconstruction), with Mr. James Kemble, London House, Mevagissey, as liquidator.

MESSRS. GEIPEL & LANGE, electrical and mechanical engineers, Vulcan Works, St. Thomas Street, London.—Messrs. W. Geipel and F. M. T. Lange have dissolved partnership from November 1st last. Mr. Geipel will attend to debts, and continue the business.

THE ENGINEERING TIMES CO., LTD.—This company is winding up voluntarily with Mr. B. Marwood, 6, Bouverie Street, E.C., as liquidator, to whom creditors are to send particulars of debts, &c., by February 15th.

MESSRS. STORIE & WHITEHEAD, consulting engineers, Station Buildings, Rochdale.—Messrs. G. B. Storie & H. F. C. Whitehead have dissolved partnership. Debts will be attended to by H. Oldham, The Orchard, Rochdale.

Trade Announcements.—Owing to pressure of business Messrs. Berry, Skinner & Co. found it necessary to extend their works at Birmingham, and adjoining premises have been taken, which they expect will enable them to double their present output. The recent difficulty experienced in giving prompt delivery will now be obviated.

Messrs. Falconar, Cross & Co. are removing on January 19th to more commodious premises, situated at 16, Lisle Street, Newcastle-on-Tyne.

Mr. H. I. Lewenz, A.M.I Mech.E., A.M I E.E , late of the London Electric Supply Corporation, has entered into partnership with Mr. C F Brown (of Glasgow), and they will trade under the name of Hillier & Co., mechanical and electrical engineers, their works and head office being situated at Romsey, in Hampshire. Their specialities will be the manufacture of internal combustion engines for paraffin and petrol, and the installation of electric lighting and power plant.

Messrs. Walters & Co., formerly of 45, Newhall Street, Birmingham, engineers and power experts, have removed to larger and more central premises at Ocean Chambers, Birmingham, to meet increased business. They are the sole Midland representatives for the Rhodes Electrical Manufacturing Co ; Reavell & Co. ; E. P. Allam & Co., Ltd. ; William Sanders, of Wednesbury ; S. H. Heywood, of Reddish ; and the Brockie-Pell Arc Lamp, Ltd.

Bergtheil & Young, Ltd., v. Cunningham.—With reference to our recent note on this case, Messrs. Andrews, Fawcus, Ogilvie & Fisher, of 18, Essex Street, Strand, write as follows under date January 9th:—"You have a note of this action under the heading 'Business Notes' in your issue of January 4th, calculated to mislead your readers with regard to the facts of the case. It is a small and somewhat unimportant case, but we are sure you do not wish to say anything that is not correct, and would, therefore, inform you that our clients, Messrs. Bergtheil & Young, Ltd., obtained judgment in their favour in the Mayor's Court, and the defendant applied at the Divisional Court for a new trial on various grounds. The Divisional Court certainly did not express any opinion as to whether the decision was a right or a wrong one, but thought that the jury did not understand the case, and that a new trial ought to be allowed. We are instructed to ask you to be good enough to state that the Court did not say that there was a wrong decision, but simply granted the defendant's application for a new trial on the ground that the jury did not understand the case."

For Sale.—On January 30th and 31st Mr. T. H. Richardson will offer for sale the stock-in-trade of an electrical engineer at Ilkeston. Some particulars appear among our advertisements to-day.

LIGHTING and POWER NOTES.

Annfield Plain.—Schemes of public lighting by gas and electricity have been submitted to the U.D.C. The E.L. scheme, providing for a power station, is estimated to cost £20,823, while the cost of erecting gas works is placed at £35,000, and a supply of gas in bulk, at £23,400.

Barrow.—The Corporation is further extending its electricity works.

Bolton.—At the No. 1 Eagley Mill electric driving is to supersede steam power. The mill is the property of Messrs. J. & P. Coats, of Paisley.

Chichester.—The B. of T. has deferred for a time consideration of the revocation of the E.L. order.

Canada.—Fort William.—The working of the municipal plant has, during 1906, resulted in a net profit to the town of $1,000, after payment of financial and depreciation charges.

Ottawa.—The Dominion Government has decided to introduce legislation during the next session of Parliament to impose an export duty upon electrical energy, and to forbid any company from exporting power without a licence, to be granted in accordance with regulations to be prescribed by the Governor in Council. The object of the proposed legislation is to ensure to Canadian consumers all the power they require at reasonable prices. It will be provided that a company which complies with the regulations which the Government will lay down, may be relieved of the payment of the export duty. Niagara Falls is the most important point to which the new legislation will apply. United States capitalists have perfected plans for meeting the demand for electrical energy at points south of the boundary line, regardless of whether the wants of the Canadian consumer are adequately satisfied or not. The Dominion Government will insist upon the Canadian market being served first, otherwise the export duty will be made effective. The amount of the duty proposed has not transpired, but it is believed that it will be a sufficiently large sum to prevent any sacrifice of Canadian interests.

Portage La Prairie.—This rapidly growing and progressive town of the north-west has decided to take practical steps towards the municipalisation of the electric plant. The estimated cost is $50,000.

Toronto.—In regard to the question of the municipality entering into negotiations with the Hydo-Electric Power Commission for a supply of electrical energy at a low price, private electrical interests in Toronto are opposing the proposed by-law. A manifesto has been issued, signed by the President of the Canadian Electrical Association and several well-known experts, adversely criticising the conclusions and engineering features of the Hydro-Electric Commission's scheme. The principal reasons for dissenting from the findings of the Commission are as follows:—That inasmuch as the estimated amount of power used in Toronto city, is, say, 20,000 h.p., and that some 15,000 h.p. of this is partially controlled by the Electric Light Co for five years, and the Street Railway Co. for 15 years, it leaves only 5,000 h.p. available for general distribution, and this is split up into small units in comparatively small stores and public buildings. That this small distribution to the widely-spread small consumers in Toronto would be comparatively much more costly than in a city like New York, where on its main streets is an extensive series of immense skyscrapers, each using a large amount of power. That, although the exceptionally unfavourable conditions of distribution in Toronto make delivery of power very expensive, the five sub-stations, storage battery reserve plant, and underground conduits would have to be on as elaborate a scale, and be practically as expensive as if the demand was over a more closely confined area. The approximate cost of a modern distribution and storage plant to deliver 15,000 h.p. would be from $3,000,000 to $4,000,000, the actual cost depending upon the relative proportions of underground and overhead distribution. That on account of the great diversity of operation—street lighting one system, incandescent lighting another system, and varying power for motors on still other systems, widely scattered—Toronto presents one of the hardest problems in securing "even pressure" on the lines throughout the city that the constructional electrical engineer has to face, entailing an elaborate system of automatic regulation. That, on reasonable estimates, therefore, taking all these special conditions and circumstances into consideration, they consider the figure for distribution quoted by the Commission's engineer, viz., $4 to $6, is absurd, and that a more reasonable figure would be about $20. This, added to the $18.10 (the Commission's ridiculously low estimated cost of power in bulk to the municipality at the city's outskirts) would make even this price to consumers, $38 per h.p., instead of the $17 which the public were at first led to believe would be the price. Supporters of the new scheme say that private companies and others will have to adjust their prices and profits to meet the new situation.

A by-law has been carried by a very large majority, authorising the T.C. to enter into negotiation with the Ontario Hydro-Electric Power Commission for a supply of power from Niagara.

Niagara Falls (Ont.).—The Ontario Power Co. has recently increased its plant by the purchase of two A.C. generators, of 7,460 kw., three-phase, 12,000 volts, 25 cycles, with the necessary switchboard apparatus, from the Canadian Westinghouse Co. At the present time the Ontario Power Co. has four similar Westinghouse generators installed.

Hamilton.—The Hamilton Electric Light Co. is fighting an action which has been brought against it by the Royal Electric Light Co. and the Montreal Light, Heat and Power Co., for the value of two dynamos supplied, and which the Hamilton Co. refused to pay for, claiming that they were not up to specification. The amount involved is nearly $100,000. The matter has been in dispute since 1899. The case came on for hearing on December 21st and was adjourned until January. The chief feature of the evidence was a point touching upon the temperature of the machines. Several electrical experts are to give evidence, and it is expected that the case will last several days.

Continental Notes.—Naples and Rome.—The facilities afforded by the law of 1904 for the establishment of new industries within the region of Naples, are resulting in the foundation and projection of works and factories, which have, or will have, large requirements in the matter of electric light and power. Not only so, but the tramways at Naples, which are still worked by steam are expected to be converted to electric traction at no distant date, and a permanent demand for from 50,000 to 60,000 h.p. is in prospect for dealing with these developments. The supply companies propose to make arrangements for coping with the anticipated expansion. One of these is the Società Meridionale di Elettricità and the second and third are the Società Generale per l'Illuminazione, which undertakes the public lighting of the town, and the Società Napoletana per Imprese Elettriche respectively. It is stated that the latter two companies propose to amalgamate, one being already financially interested in the other, for the purpose of preventing mutual competition. At Rome the Municipal Council contemplates the erection of a generating station for public and private lighting, and for the working of tramways. A scheme has already been prepared which, in the absence of a suitable water-power, provides for the establishment of a steam power station of a capacity of 3,000 h.p. by way of a beginning and capable of extension to 10,000 h.p. The expenditure on the initial plant is estimated at £140,000, and on the extended works the total outlay is computed at £520,000.

Italy.—The Società Elettrica de la Riviera di Ponente, with headquarters at Milan, proposes to erect a water power plant on the River Roya. The volume of water to be taken is estimated at 5,000 litres, sufficient to develop about 7,600 h.p., but the station is to be arranged so that a further volume of 3,000 litres can be utilised. It

is intended to distribute energy over the district between Vintimille and Savona.

SPAIN.—The municipality of Nerpio (Albacete) has just invited tenders for a concession for the electric lighting of the town during a period of 25 years.

SWEDEN.—The Gullspang-Munkfors Kraftaktiebolag is actively proceeding with the erection of its power station at the Monkfalls, which is designed to furnish 12,000 H.P., and will be the largest in Southern and Central Sweden, next to Trollhätten. Construction and equipment are estimated to cost 5,000,000 kroner, and it is calculated that a saving to the country of 1,500,000 kroner for imported coal will be effected by its installation. Orders for the machinery have been placed with the Allmanna Elektriska Aktiebolag (General Electric Co.) and comprise three 4,000-H.P. generators and complementary transformers for a pressure of up to 40,000 volts. The installation is expected to be completed by the autumn.

VOSGES.—There are in this department 26 generating stations supplying 41 localities. Of these stations, 19 supply a single locality, and 7 several localities. Only 6 of them are worked by steam, the remaining 20 making use of water power. Of the latter, 4 supplement their generating capacity by steam and 2 by suction gas power. Seventeen stations supply continuous current, 3 single-phase alternating current, 5 three-phase, and 1 continuous and three-phase current. The distribution of continuous current is made on the two-wire (at pressures of from 110 to 240 volts) and three-wire (at 230 and 300 volts) systems. The alternating supply has a frequency of 50 cycles, and is transmitted at 2,000, 3,000, 4,000, and 5,000 volts, and transformed down for use to 110 to 125 volts. Besides these public stations, there is a large number of private installations supplying especially a number of spinning mills with light and power.

Darlington.—In view of the extensions to be made in the electricity works, the Electricity Committee of the T.C. has decided not to grant the application of the Cleveland and South Durham Electric Power Co., for permission to supply energy in the borough.

Dartford.—The U.D.C. has applied for a loan of £1,000 for the extensions at the electricity works.

Denny.—The Scottish Electric Power Co. has made certain alterations in the draft agreement with the T.C. of Denny and Dunipace, containing the terms on which it is prepared to supply electrical energy to the Council. The result of the alterations will raise the price per unit, will necessitate the introduction of additional plant by the Council, and otherwise increase its responsibilities. The Council considers that the terms now offered by the company are unreasonable, and has instructed the E.L. Committee to resume consideration of the proposal to install generating plant itself.

Edmonton.—The North Metropolitan E.P. Supply Co. has notified the U.D.C. that it intends to commence works in connection with the E.L. order for the district, recently taken over by the company.

Failsworth.—In response to complaints made by the U.D.C. in regard to the delay on the part of the Manchester Corporation Electricity Committee in providing a supply of electrical energy in the district, it has been decided to make a further canvass with the object of ascertaining the probable demand.

Haslingden.—The T.C. has decided to oppose the application of the Lancashire Electric Power Co. for E.L. powers. The Kearsley U.D.C. will also formally oppose the company's Bill in respect of supply to that Council's district.

Hove.—The T.C. has decided to give consumers of energy for heating and power an alternative flat rate of 3½d. per unit or a charge of 2d. per unit, with a maximum charge of 10s. per quarter, and 5s. per quarter rental for use of time switch.

London.—MARYLEBONE.—A business and development department has been organised in connection with the electricity supply undertaking, and will shortly be in full working order. Besides procuring new connections, it undertakes the equally important work of advising consumers on their installations and dealing with their complaints. A showroom has been fitted up at the offices of the Electricity Department, 19 and 20, York Place, and is proving of great assistance, especially in demonstrating to consumers the possibilities of electric heating and power. In both these fields there is much work to be done in Marylebone: the power and heating rates of 2d. and 1d. per unit on the maximum demand system are very reasonable, and the prime cost of the apparatus is not so great a bar to progress as it might be in a less wealthy district. A complete series of pamphlets on the various phases of electricity supply, and other publications of a like nature, have been got out; and free wiring, hire and hire-purchase schemes will shortly lend aid to the development of the undertaking.

CAMBERWELL.—The B. of T. has informed the B.C. that in regard to the electricity supply in the Crystal Palace district, it has received from the undertakers (the South Metropolitan Electric Light and Power Co.) a description of an additional system at extra high pressure which they propose to use. The supply will be furnished from the generating stations to sub-stations at a pressure of 10,000 volts alternating current, at a frequency of 50 periods.

PADDINGTON.—The B.C. has adopted the following charges in connection with the reinstatement of footways and carriageways when disturbed by public companies and authorities other than the Post Office, viz., 1 in. asphalt paving on 4 in. concrete, 14s. per sq. yd.; 1½ in. asphalt paving on 6 in. concrete, 17s. per sq. yd.; 1½ in. asphalt paving on no concrete, 12s. 6d. per sq. yd.; 1½ in. Lithofalt asphalt on 6 in. concrete, 17s. per sq. yd.; 2 in. asphalt on 6 in. concrete, 19s. per sq. yd.; 2 in. asphalt on no concrete, 14s. 6d. per sq. yd.; concrete only 1 in. thickness, 1s. per sq. yd.

SHOREDITCH.—The B.C. has instructed its Lighting Committee to report upon the position, financial and otherwise, of the E.L. undertaking.

STEPNEY.—The Finance Committee has passed an estimate of £10,500 for mains extensions. The Electric Light Committee recommends that it be instructed to formulate a scheme for putting into operation the provisions of Part V of the L.C.C. (General Powers) Act, 1906, dealing with the supply of electric fittings by metropolitan B.C.'s, and to submit such scheme to the Council for approval. The Committee is in communication with electrical contractors upon the question, and upon obtaining their views it would consider the matter of recommending the Council to carry out the powers referred to either by itself or through the medium of contractors or jointly. Should the Committee ultimately recommend the Council to let a contractor undertake the work, one of the conditions will probably be that any consumer or prospective consumer should be advised by the Council upon the subject of his installation. One large consumer has intimated that unless the Council takes some steps to carry out such alterations to his installation as will effect a considerable economy in the consumption of energy, he will have no alternative but to cease taking a supply from the Council.

FULHAM.—In regard to the loan of £14,000 sanctioned by the L.C.C. for E.L. purposes, the B.C. is to take up £6,663 and allow the remaining portion of the loan to stand over in the hope that the money market will be in a better position after a time, and that the L.C.C. may be able to reduce the proposed rate of interest (4 per cent.).

Norwich.—On the recommendation of the city electrical engineer, Mr. F. M. Long, the Electricity Committee has resolved to offer private consumers an alternative tariff of a novel character, namely, a fixed charge of 12½ per cent. per annum on the net assessment (which includes the meter rent), and 1d. per unit for all energy consumed. The new system starts from the New Year, and it will be interesting to follow its working.

South Lancashire.—A local correspondent informs us that three leading colliery firms are making arrangements for adopting electricity on a large scale for haulage and ventilating purposes, but that they do not wish it made public at present.

Stafford.—The Corporation has resolved to extend the scale of discounts to consumers as follows:—From 1,400 to 2,000 units per quarter, 10 per cent.; from 2,000 to 3,000, 12½ per cent.; over 3,000, 15 per cent.: and so on, up to 14,000 units per quarter.

Sunderland.—At the meeting of the T.C. on the 9th inst., Alderman Bruce moved the adoption of the Electricity and Lighting Committee's report, which recommended an extension at Hylton Road electricity station at a cost of £44,450. He said that all the plant was at present being used, owing to the heavy demand with which they had to cope. That demand was increasing, so that they could no longer delay coming to the Council to authorise the scheme. The total capital of the undertaking was put down at £396,500, yet they had a sinking fund and a reserve account of £63,000, which it was estimated would be carried to £80,985 next year. Their estimated gross earning power for next year was 7 per cent. The Committee had an undertaking from Messrs. Doxford & Sons (the firm taking the largest supply) that in the event of the works being closed down the latter would meet the interest and sinking fund, and the standing charges the Committee were put to in putting down the plant for them, and the other firms had agreed that if only half time was worked, the price per unit of the supply of power should be raised. Alderman Bruce said the extension of the station was necessary and imperative. It was proposed to put in a turbine set of 2,000 KW. The report was adopted.

Tasmania.—LAUNCESTON.—The Mayor, in a recent address to the City Council, stated in regard to the electrical undertaking that during last year (1905) motors totalling 424 H.P. were connected to the mains, and this year (1906) there were 765 H.P. connected up. Lamp connections had increased from 33,564 8-C.P. to 35,071; 1,700 of the 2,000 meters had been recalibrated for a frequency of 50 periods in place of a frequency of 92. Street lighting had been improved by the addition of 47 new lamps.

United States.—NIAGARA FALLS (N.Y.).—It is reported from Washington that the Secretary of State is preparing to take up for final decision the various complex questions presented to him under the terms of the Burton Act relative to the conservation of the waters of the Niagara River, so as to prevent the sacrifice of the falls to the commercial interests of the country. The electric lighting and power companies contend that the Government has no authority to undertake to regulate the disposition of the waters of streams, save where the navigation thereof is concerned. Grave constitutional questions are involved. So

far, however, the right of the United States Government to regulate the admission of electricity generated on the Canadian side of the river has not been challenged, and it is reported that Mr. Taft intends to devote himself to this aspect of the question first.

Willesden.—At the meeting of the U.D.C. on Tuesday, the clerk reported that the North Metropolitan Electric Power Supply Co. had agreed to pay the full amount (£1,848 6s. 5d.) claimed by the Council under the terms of Clause 15 of the agreement dated February, 1904, whereby the company guaranteed repayment of any deficit upon the electricity undertaking for a period of three years to the extent of £4,894.

Williton.—The R.D.C. has decided to consent to the application of the Minehead Electric Supply Co. for an E.L. prov. order on condition that the roads are not disturbed during August and September in each year.

Windsor. — The Windsor Electric Installation Co. announces that as from the 1st of this month the charge for energy for outside shop lighting by arc lamps will be 4d. per unit. At the same time that the company makes this announcement, it is issuing a neat little pamphlet on the cost and merits of electricity *versus* gas. The better efficiency of the tantalum lamp enables a very favourable comparison to be made in the case of electricity over gas for ordinary lighting.

TRAMWAY and RAILWAY NOTES.

Canada.—BERLIN (ONT.).—The franchise of the Berlin and Waterloo Street Railway Co. expired last September, and a board of arbitration has just issued its award. The T.C. desires to carry on the undertaking as a municipal concern. The arbitrators valued the plant at $75,200, and allowed nothing for the Waterloo franchise, which has not yet expired. The company valued the plant, including the Waterloo franchise and 10 per cent. as a going concern, at $201,000. The award is regarded as very satisfactory to the town, but it is generally expected that the company will appeal against the arbitrator's decision.

WHITBY.—The Huron and Ontario Railway Co., which is constructing an electric line from Kincardine to Port Perry and Whitby, proposes to make the latter town the terminus for the present, although an ultimate extension to Toronto is contemplated. Provided a by-law is adopted by the ratepayers of Whitby at the January civic elections, the railway company will be granted as an inducement to establish itself at Whitby a free site and an annual payment of $2,000 for 12 years, on condition that the company employs 40 residents of Whitby continuously, and that the monthly pay roll amounts to $2,500. The people of Whitby are interested in the new railway, as it may revive the business of the port by making it an outlet for grain from the West coming over the new railway from Georgian Bay and Lake Huron ports.

Continental Notes.—BERLIN CONDUIT TRAMWAYS.—If the statements made in regard to the few sections of conduit electric tramways in Berlin are correct, the construction of the lines cannot have been carried out in an efficient manner. The difference of potential maintained in the Berlin conduit is 500 volts. In damp weather short circuits take place in the conduit, and this is especially the case when water lies at the bottom of the conduit, which unfailingly occurs in times of sudden showers and thaws, as the drainage system of Berlin is declared to be inadequate for the purpose of carrying off the water. It is also stated that the supply cables are often damp at their junction with the collector rails, thus impairing the insulation. The ploughs cause many interruptions as they jam and bend on insertion into, or withdrawal from, the narrow slot, and if they are damp they also produce short circuits, whilst at the same time trouble is experienced from the switches which deal with both the track and the collector rails in the conduit underneath. As the simultaneous movement of both is difficult for manual labour, the switches are operated by electricity, and these again frequently fail to accomplish their purpose. All these inconveniences manifest themselves, particularly in wet weather, snow and frost, and they represent the causes of the interruptions which have recently taken place, as was mentioned in our pages last week.

BERLIN ELEVATED RAILWAY.—After slight stoppages in the train services on the afternoon of the 3rd inst. a serious fault occurred in the cable network, stopping the train services between the eastern and western sections. According to a statement issued it was difficult to localise the fault, which was only possible after the line was shut down. The full service was not resumed until the following morning.

ITALY.—The Société Anonyme du Tramway et Chemins de Fer Electriques de Rome-Civita Castellana-Viterbe, which is a Belgian company domiciled at Brussels, occupies a favourable position in Italy from the fact that, instead of being financially bled by local authorities, as in the case of private tramways in some parts of England, it is actually in the receipt of an annual subsidy from the Government and the provincial and municipal authorities. At present the company has an overhead trolley line in operation between Rome and Civita-Castellana, which has a total length of 33·4 miles. As we briefly stated last week, it is now proposed to extend the line from Civita-Castellana to Viterbo, a distance of 26·6 miles, and an annual subsidy of £8,000 has been granted by the before-mentioned authorities, irrespective of any developments which may take place in the traffic on this particular mileage. As the original line is already in enjoyment of a subvention of £2,600, the total subvention will be seen to amount to £10,600, and this has been fixed for a period of 35 years. The total length of the tramway or railway will then be 60 miles, the system used being the single-phase alternating-current method. The extension of the tramway will serve a region which is considered to be the most fertile and the best cultivated in the province of Rome, where most of the communes at present have no means of railway communication. All these communes will be placed in connection with Viterbo, which is the administrative and judicial centre of the region, and also with Rome by the existing Rome-Civita-Castellana line. Apart from an issue of bonds, the company has a share capital of £52,000, and this is being increased to £120,000 by a new emission of 17,000 shares of £4 each, which have been offered in Brussels at a premium of 10s. per share.

La Società Livornese di Trazione Elettrica is the name of a company which has just been formed at Leghorn, with a capital of £11,000, to construct and work an electric tramway in the town.

FRANCE.—An electric tramway accident occurred at St. Etienne on Saturday last, which resulted in the death of two passengers and severe injuries to 25 others. A car ran away down an incline.

BELGIUM.—The question of the establishment of a system of electric tramways in Bruges is, says a Belgian contemporary, quite settled. The system will have a total length of 23½ km., and will require a capital of 2,200,000 fr. The State and the provincial authorities will supply one-half and one-quarter of this amount respectively; the other quarter will be subscribed by the several communes served. In addition to the lines in Bruges itself, the following lines are to be constructed:—Bruges-l'Ecluse-Heyst, Swevezcele, Knesselaere-Ursel, Aardenburg and Leke-Dixmude.

Egypt.—Great developments are expected with regard to the Cairo electric tramways. A company has been formed in Paris with a capital of £800,000 with the object of acquiring from the Cairo Electric Railways and Heliopolis Oasis Co., for the sum of £200,000, their lands and concessions at Heliopolis. The original company has increased its capital by 60,000 shares of £10 each (the ordinary shares of the company are quoted in Paris at £14), and great extensions of the system are expected.

Harlesden.—A collision occurred between an electric tramcar and a coal van last week, and the driver of the latter was killed.

Jarrow-on-Tyne.—At the meeting of the T.C. on the 10th inst. a letter was received from the Board of Trade enclosing a communication from Mr. Sidney Morse, solicitor to the B.E.T. Co., in which was stated: "With reference to your letter, dated 4th inst., transmitting a copy of a portion of a letter received from the Jarrow Corporation, my clients desire me to say that, in the event of their obtaining powers for the construction of a line through Hebburn, connecting up the Gateshead tramway system, they would undertake to construct the present railway No. 2 (Albert Road section) at the same time as they construct the line to Gateshead, provided they are not called upon to construct it otherwise." The letter was referred to the Tramways Committee.

Liverpool.—The report of the year's working of the Liverpool tramways was submitted to the Tramways Committee at a meeting on Friday afternoon last. The car-mileage for the year was 12,115,934 miles; number of passengers carried 122,094,528; and the receipts, £563,793. This was an increase of £13,672 on 1905 in revenue, and of 2,970,884, or 2·5 per cent. in the number of passengers carried. The mileage showed an increase of 48,901 on that of 1905, and the average earnings per car-mile were 11·17d. as against 10·94d. in 1905. The totals are the highest yet reached in the working of the Liverpool tramways. In 1897, the year in which the Corporation took over the tramways, 38,409,084 passengers were carried, the cars ran 6,013,182 miles, and the receipts were £290,743. In 1899, the year in which the tramways were electrified, the receipts rose to £359,929. Recommendations for changes in routes and services by the sub-committee were considered by the committee, and approved of. The principal change recommended is in routes at the north end of the city. To establish communication between Walton and the North Docks, a new route is proposed of a length of 9 miles 280 yds.

London.—ST. PANCRAS.—Owing to the B.C. not consenting to the adoption of the overhead trolley system for the tramways on certain streets within the borough, the L.C.C. has intimated that although it included these tramways in the provisional programme of works to be executed during the financial year ending March 31st, 1908, "the County Council feels reluctantly compelled to withdraw these lines from the above-mentioned programme of works, and to substitute tramway works elsewhere."

Manchester.—The proposed tramway extensions in Manchester have aroused considerable opposition on the part of a section of the community. The statutory meeting of the ratepayers called to sanction the intended Bill in Parliament was a very disorderly one. At times it was impossible to hear speakers on the platform, and much of the business was transacted in quiet moments between the frequent spells of rowdiness. Two resolutions were lost, and some were declared carried, when many in the room had no idea of what was transpiring. The two lost resolutions had reference to the proposed new routes in Plymouth Grove West and Wilbraham Road, while the resolutions said to be carried

were in regard to proposed lines from Moston Lane to Kenyon Lane, and in New Bridge Street, Great Western Street, Ashton Old Road, and other thoroughfares; also for road widenings at Northenden and other places. In the course of the proceedings (the Lord Mayor being in the chair), the Chairman of the Tramways Committee, Mr. Wainwright, said the Manchester ratepayers were getting 8¼ per cent. return on the one and three quarter millions invested in the tramway undertaking. The subject will be further considered at a special meeting of the City Council, and it is anticipated that a poll of the ratepayers will take place.

Mr. Wainwright last week informed a deputation which waited on the Tramways Committee on tramway matters that the Committee was under obligations to the Sale U.D.C. with reference to works contemplated there. The Manchester to Stretford service was at first anything but remunerative, but since the opening of the Timperley extension, those lines had become very remunerative, and, indeed, are of the best branches of the tramway undertaking. The Sale and Timperley districts had now a large population, and required extended tramway facilities. It was intended to complete the circular route from Manchester, by way of Chester Road and Sale, to Northenden and Palatine Road, and, to do this, powers for road widening were necessary.

A small length of tramway line, branching off from the Sale and Timperley line, and extending by way of Chapel Road to Sale Bridge, will bring the Manchester tramways into closer competition with the Manchester South Junction and Altrincham Railway Co. This branch will ultimately form part of the intended Sale and Northenden route. It will be open for traffic shortly.

Work has this week been begun on the two miles of new tramway line between West Timperley and Altrincham, which will connect the latter town with Manchester. The Altrincham U.D.C. has arranged to borrow, under the authority of their provisional order, a sum of £20,000, which, it is expected, will cover the cost of the undertaking, including some necessary road widening and the lowering of the highway under the railway bridges at Broadheath and West Timperley. By agreement with the Manchester Corporation, the tramway is to be constructed and equipped by the latter authority, at a charge of 10 per cent. over the actual cost. The line will be leased to the Corporation for a period of 23 years, during which time the entire loan, with interest, will be repaid in the form of rental. At the expiration of the lease the line will become the property of the Altrincham Council, and it will have the option of taking over the overhead equipment, or adopting any other form of traction. It is expected that through communication between Manchester and Altrincham will be established about Easter.

Lowestoft.—The T.C. has had to make good a deficiency on its tramways, for the year ended September 30th last, of £537. No provision has been made for depreciation in respect to the past year's working A proposed doubling of the track from Camden Street (North) to Pakefield (South) has been postponed.

Rangoon.—From *Indian Engineering* we learn that the electric tramways were opened for traffic on December 15th last.

Rawtenstall.—The following official statement has been prepared by the Mayor of Rawtenstall in connection with the Tramway Bill being promoted in Parliament, and which was considered at an adjourned town's meeting on the 15th inst.:—Estimated cost of reconstructing and electrifying the existing tramways in Rawtenstall and Bacup—Reconstruction of Accrington tramways, £8,900; ditto, of Rawtenstall tramways, £32,300; Bacup, £17,600; total, £58,800. Overhead equipment—Accrington, £1,579; Rawtenstall, £5,463; Bacup, £3,325—total, £10,367; feeder cables, rolling stock, engineering, &c., £16,114; grand total, £85,281; less value of scrap, £6,700; leaving £78,581. The estimated capital expenditure, including purchasing, reconstructing and electrifying, £99,411. Estimated working results—Receipts, 432,160 car-miles at 9·75d. per car-mile, £17,556; expenses, 432,160 miles at 6d. = £10,804, leaving £6,752; less interest and sinking fund on £99,411 for 30 years = £5,600, leaving a balance of profit of £1,152. Provided the Corporation and the two tramway companies cannot agree as to the price to be paid for the existing tramways, the price will have to be settled by arbitration, and even if the arbitrator's award is as much as £10,000 over the Corporation's valuation, there would still be a profit of £600. The Bill also provides for the raising of £3,000 for motors and apparatus in connection with the electrical undertaking.

South America.—BUENOS AYRES.—According to the *Review of the River Plate* the municipality has drawn up a scheme for the construction of electric "tubes. Plans and details have been forwarded to a special Parliamentary Committee. The length of the first section proposed is 10,260 metres, and the estimated cost of the work $19,517,000, paper.

South Lancashire.—The South Lancashire Tramways Co.'s new length from Newtown, Pendlebury, to Unity Brook, Kearsley, is completed, and will be open for public traffic in a week or two. It is not intended, it is understood, to proceed with the construction of lines from Walkden to Over Hulton—nearly four miles—at present.

Torquay.—The Torquay motor-omnibuses have been sold, and are shortly to be transferred to Harrogate, where they are to be introduced for the use of residents and visitors as a cheap and quick mode of locomotion. When a company was formed at Torquay for the introduction of motor-'buses, and they were started, between three and four years ago, it was not then quite certain that tramways would come, but as this has since become an accomplished fact, so far as the tracks alone are concerned, the directors of the Motor Omnibus Co. have taken advantage of an offer by the directors of a similar company at Harrogate. The arrangement to sell is a provisional one, and has to be ratified by the shareholders. The Dolter Electric Traction Co., we are once more informed, is now hastening on its arrangements for starting the running of cars at Torquay.

Taunton.—Subject to certain suggestions being carried out, the T.C. has agreed to assent to the order being promoted in the coming session of Parliament by the Taunton Electric Traction Co. for powers to extend their system to Rowbarton.

Tottenham.—The Council's engineer is to commence the work of widening Seven Sisters Road at the expense of the Metropolitan Electric Tramways, Ltd., as soon as the money is deposited by the company.

Walsall.—The Birmingham T.C. has intimated to the Corporation that it has no intention of applying for powers to construct a tramway from Perry Barr to the Scott Arms Hotel. The Perry Barr and Handsworth U.D. Councils have also stated that they cannot entertain the matter at present. In consequence of these decisions, the Walsall Corporation has postponed for three months the question of extending its system from Great Barr to the Scott Arms Hotel, as authorised in its 1900 order.

Yarmouth.—By a large majority the T.C. has decided to extend the tramways to Caister-on-Sea, a distance of 2 miles, at a cost of £14,000.

TELEGRAPH and TELEPHONE NOTES.

Canada.—The accounts of the municipal telephone plant at Fort William, Ontario, for 1906, show receipts of $12,628, as compared with $9,620 in 1905. Although the townspeople pay only $2 a month for business telephones and $12 a year for residence telephones, the profit for 1906, after providing for sinking fund and interest, and 10 per cent. for depreciation in value of plant, amounted to no less than $3,300.

Egypt.—The Austro-Hungarian Consul at Cairo in a recent report states that the use of the telegraph was considerably extended in 1905, particularly the use by the native population; the number of telegrams in European languages dispatched in 1905 amounted to 677,000, and the number of telegrams in Arabic increased from 1,089,000 to 1,248,000. The length of line was increased by 603 kilometres. The use of the telephone is also rapidly extending. In most of the provinces the chief towns are in communication with one another as well as with the chief towns of other provinces, and it is anticipated that this communication will soon cover the whole of the country. At the end of 1905 1,036 telephone lines were working and 850 new lines projected.

Servia.—The Austo-Hungarian Consul at Belgrade reports that the number of telegrams dispatched in Servia in 1905 amounted to 1,382,194. The length of telegraph line at the end of 1905 was 3,281·6 kilometres (no increase), length of wire 7,724·9 kilometres (increase 510·9 kilometres); there were 173 stations. The municipal telephone lines included 506 kilometres overhead line, and 11 kilometres cable line, with a length of wire of 4,930 kilometres; for the inter-urban traffic, Servia had a length of line of 1,384·2 kilometres, with a length of wire of 2,054·9 kilometres; there were 1,495 stations. The number of messages in 1905, for the municipal traffic, amounted to 2,259,667, and for the inter-urban traffic 139,874; receipts 208,012·6 fr. Arrangements were made in 1904 between the Servian and Hungarian Governments for telephonic communication between Budapest and Belgrade, and between Zimony and Belgrade, the lines being opened on November 20th, 1905.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Paramaribo Cayenne	Nov. 27, 1906	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-Martinique	May 7, 1902	
Dominica-Martinique	May 7, 1902	
Guadeloupe-Martinique	Aug. 29, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Curacao-Coro, Curacao-La Guayra, Curacao-Maracaibo	Closed.. Jan. 12, 1906	
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1903	
Tarifa-Tangier	Jan. 18, 1904	
Port Arthur-Chifu (Closed)	Mar. 9, 1904	
Garachico-Santa Cruz	July 12, 1906	
Las Palmas-Arecife	Aug. 18, 1906	
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	
Mole St. Nicholas-Cap Haytien	Nov. 22, 1906	
Fao-Bushire	Dec. 4, 1906	
Martinique-Paramaribo	Dec. 17, 1906	
Gibraltar-Tangier	Jan. 2, 1907	
New Brunswick-Prince Edward Island	Jan. 9, 1907	
LANDLINES.		
Puerto-Barrios	Aug. 28, 1902	
Soukhoum Kale-Tiflas	Jan. 12, 1907	Jan. 13
Bagdad-Bassorah	Jan. 12, 1907	Jan. 13

Telephone Agreements.—On the application of Sir Robt. Hunter, solicitor to the Post Office, last week, Judge Rentoul granted a new trial in the case of the Postmaster-General *v.* King, which we recently reported.

Wireless Telegraphy.—On Saturday last the *Standard* went out of its way to quote from the *Matin*, as news, some distorted particulars of the Poulsen system, forgetful of the fact that some two months ago the *Standard* itself reported Herr Poulsen's demonstration of his system at the Queen's Hall, probably more correctly than in the present instance. Take the following, for example:—"If a wireless telegraphy post, as fitted by Herr Poulsen, sends waves of ether 600 yds. long, the corresponding post will receive waves from 594 to 606 yds. long, and the two posts will be within 2 per cent. of absolute syntonisation." Again, "An alternating current is created in the neighbourhood of an ordinary electric arc, which then emits waves" . . .

Our contemporary will evidently accept no responsibility for the information contained in the following statement:—"According to the *Matin*, the Poulsen receiver is being experimented with in England by Lord Armstrong."

It is not recorded that the *Matin* referred to Queen Anne.

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—February 11th. Boilers, superheaters, stokers, &c., for the tramways and electricity department. See "Official Notices" to-day.

Belgium.—March 30th. The municipal authorities of Liége are inviting tenders for the establishment and working of a large central electricity station for the generation and distribution of electrical energy in the Liége district. Particulars and copies of the plans may be obtained for 27 francs from the Chef du Bureau Administratif des Travaux (Annexe de l'Hotel de Ville), and tenders are to be sent to Le Secretariat, Hotel de Ville, Liége.

Bermondsey.—February 6th. Carbons, conduits, meters, cables, &c., for the electricity and destructor department of the Council for one year. See "Official Notices" January 11th.

Bridlington.—January 19th. Pumping machinery for the Corporation waterworks. See "Official Notices" November 30th.

Cannes.—January 31st. The municipality announces that the gas and electric concessions terminate on August 31st, 1908. Although these companies have the right to supply, without monopoly, private consumers until 1935, they are prepared to receive tenders from those desirous of obtaining one or both of these concessions, separately or together. Offers should reach the Secretariat de la Mairie before January 31st, 1907.

Derby.—January 19th. Water-tube boiler, &c.; economisers; induced draught plant; coal-bunkers, conveyors, &c., for the electricity department. See "Official Notices" January 4th.

Dublin.—January 29th. The Dublin Port and Docks Board requires tenders for electrical pumping machinery and electric wharf cranes. Particulars from Mr. John P. Griffith, engineer to the Board, East Wall, Dublin, on payment of £1.

Eastbourne.—February 11th. One 750-kw. steam turbo-alternator and condensing plant for the Corporation. See "Official Notices" to-day.

Hackney.—January 24th. Arc lamp carbons for the electricity department for one year. See "Official Notices" January 11th.

Hungary.—The estimates of expenditure on the Hungarian Government electrical railways for the current year include among the new material to be acquired 8,440 sets of telegraph apparatus, and 690 km. of telegraph wire; material for the improvement of the lighting of the railway carriages, for which a sum of 30,000 kr. is scheduled; and that required for the lighting of the railway workshops.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Ilford.—January 22nd. Economiser for the U.D.C. electricity works. See "Official Notices" January 11th.

Islington.—January 24th. Tenders to the B.C. for an electrically-driven capstan. See "Official Notices" January 4th.

Launceston (Tasmania).—January 21st. Three-phase motors for one year. See "Official Notices" December 7th.

London.—January 23rd. The Metropolitan Asylums Board is inviting tenders for telephone and bell installations at the North-Eastern Fever Hospital. See "Official Notices" Jan. 4th.

L.C.C.—January 22nd. Thirteen induction motor-generators of 500 kw., and four of 150 kw. capacity. See "Official Notices" December 21st.

L.C.C.—January 22nd. 200 or 300 double-deck roof-covered car-bodies; 300 pairs of maximum traction swing bolster trucks; 300 electrical equipments for operation upon the overhead trolley and conduit system. See "Official Notices" December 28th.

Middlesex.—February 13th. The Light Railways and Tramways Committee of the County Council is inviting tenders for the construction of some miles of double track for electric traction along Harrow Road, and at Willesden and Acton. Mr. H. T. Wakelam, M.I.C.E., County Engineer, Middlesex Guildhall, Westminster, S.W.

Rathmines.—January 30th. Supplies for the U.D.C. electricity works. See "Official Notices" to-day.

Salford.—February 9th. One motor for driving a 150-kw. alternator for the Electricity Committee. See "Official Notices" to-day.

South Australia.—March 6th. The Postmaster-General requires tenders for telephone and telegraph material as follows:—Four switchboards. Thirty transformers for duplexing telephone lines, resistance of primary to be 150, that of secondary to be 300 ohms divided at 150; the ends of the copper wires must be protected through the iron sheathing. Five hundred transmitters, Deville's large pattern, lacquered brass case, nickel plated cover and mouthpiece, with fittings complete as per sealed pattern No. 35. Two miles cable, 208-pair paper-insulated lead-covered. One mile cable, 104-pair paper-insulated lead-covered. Five miles copper wire, No 20 S.W.G. tinned, insulated with one lap of pure india-rubber, double cotton-covered and paraffined. 15 miles copper wire, No. 18, insulated with vulcanised india-rubber. 100 registers, mechanical, for telephone service. 12 relays, polarised, differential armature B.P.O. pattern, resistance of each wire 300 ohms. The tongues must be hinged; the armature must remain perfectly neutral when a current of 100 milliamperes is passed through the two coils whilst connected in opposition. The relays must give reliable signals with current from one Daniell cell through an external resistance of 1,000 ohms. The wire must be not less than 36 S.W.G. (the relays are to be similar or equal to illustrations 124 and 125, Preece and Sivewright's "Telegraphy," pages 198 and 199, 1905 edition). 50 non-polar relays, 26 magneto-extension bells, 52 trembling bells with 3-in. gongs, 10 ohms resistance, with substantial platinum contacts. 12 cords, five-conductor, with five-way plug and jack for breast transmitter. 100 cords, single-conductor, 9 ft. long, for standard multiple switchboards. 60 one-half M.F. condensers, 60 ditto one M.F., 60 ditto two M.F., 24 mouthpieces, composition for micro-transmitters (combination transmitters), 24 extension switches, metallic circuit, capstan pattern.

Warrington.—January 28th. Cables, switchboard panel and transformers, for the Electricity Department. See "Official Notices" January 11th.

Whitehaven.—The Water and Electric Lighting Committee recently resolved to advertise for tenders for surface condensing plant and boiler feed pump for the electricity works, at a cost of about £1,000.

CLOSED.

Accrington.—The T.C. has accepted the tender of Yates and Thom, Ltd., for a Lancashire boiler, superheater and mechanical stoker, at £1,000.

Accrington and Bury.—Messrs. Thermit, Ltd., have received the contract from the Corporation for the welding and bonding in connection with the electrification of their tramway system. The proposed extension of the Bury Corporation tramway system will also be welded by their process.

(*Continued on page* 111.)

THE MARYLEBONE MUNICIPAL ELECTRICAL UNDERTAKING.

With the protracted negotiations which preceded the establishment of a municipal electric supply in the Metropolitan Borough of St. Marylebone, it is not our intention to deal, except very briefly, on the present occasion.

It will be recalled that the parish of St. Marylebone was originally included in the Metropolitan Electric Supply Co.'s West London Order of 1889, and that the company's generating stations in the area were situated at Rathbone Place and Manchester Square.

In 1898 the then vestry was granted a provisional order by the Board of Trade, but confirmation of the order was refused by Parliament owing to the opposition of the Metropolitan Co.

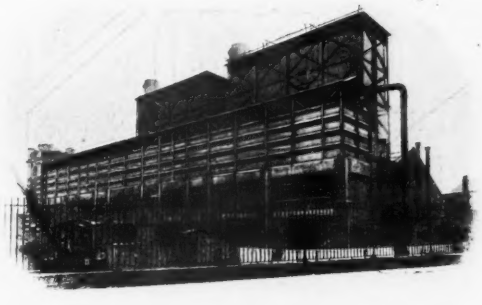


Fig. 1.—Exterior of the Generating Station, showing the Steel and Concrete Bunker Structure.

Undeterred by its lack of success on this occasion, the Borough Council again took the matter up in 1901, calling in Mr. Arthur Wright as consulting engineer and was then successful in obtaining powers to establish a supply. The Bill provided that the Metropolitan Electric Supply Co. should sell to the Borough Council its undertaking and business within the Council's area, with one or two necessary exceptions; the price was to be subject either to mutual agreement or arbitration, and, as is well known, the latter course was adopted, with the result that the figure of £1,212,000 was fixed as the price to be paid to the company.

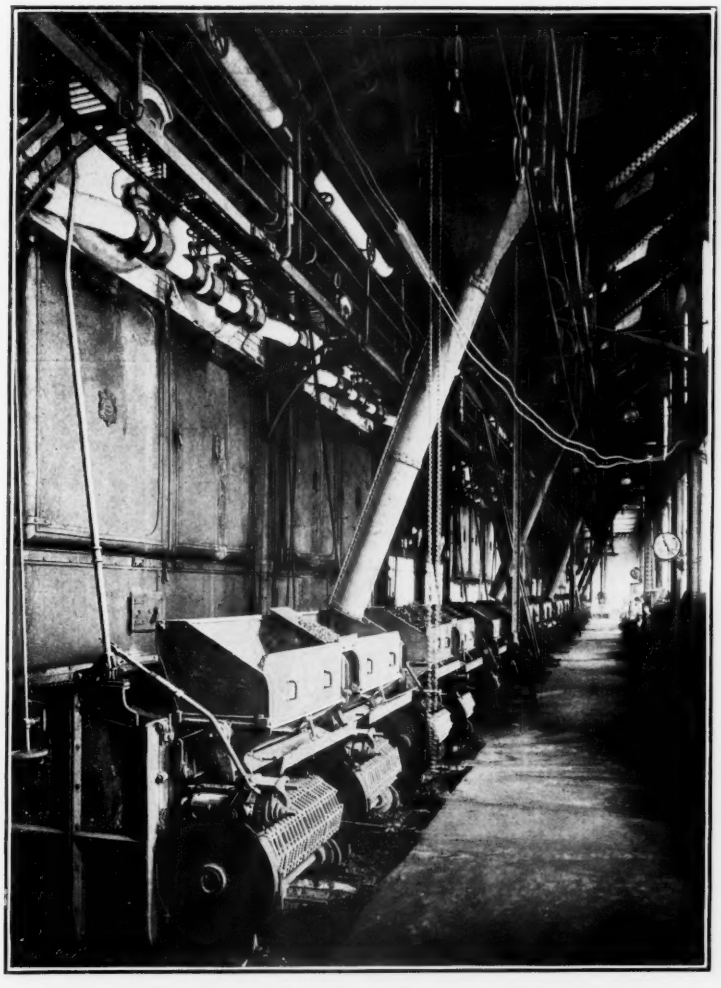


Fig. 2.—View in the Boiler House, Ingrey Travelling Weighing Machine in the Foreground.

The lengthy proceedings which led up to the award were fully described in the Electrical Review, Vols. L and LI. They form, undoubtedly, one of the most prominent pages in the history of municipal electrical enterprise.

The price mentioned was subsequently increased by some £200,000, representing the value of work carried out by the original company prior to the completion of the purchase in 1904.

Whether the sum of nearly 1½ million pounds was too much or too little for the municipality to venture on the purchase of a going concern, with the knowledge of additional expenditure to come for generating plant, &c., can, of course, only be definitely ascertained by working results. Mr. Wright, however, judging from the progress of the past year and the estimates for the year ending March next, is confident that the undertaking can be made entirely self-supporting, without assistance from the ratepayer (a result greatly facilitated, of course, by the deferment of the sinking fund repayments during the early years); further, the latter has some consolation in the fact that he is charged a less average price than that which the company had reckoned on.

Nevertheless, judged in the light of the inherent difficulties which beset municipal management of commercial undertakings, financial risks of the magnitude here involved, even if fortunately attended by no loss to the ratepayer, are not justified on principle.

In the case in point, Mr. Wright must be credited with having proceeded on the only possible lines which would enable such a heavily capitalised municipal project to emerge with any degree of success; and in being allowed to sweep away old and inefficient material taken over by the new undertaking, and to install a brand new and most efficient generating plant for supplying the area, he was more than fortunate.

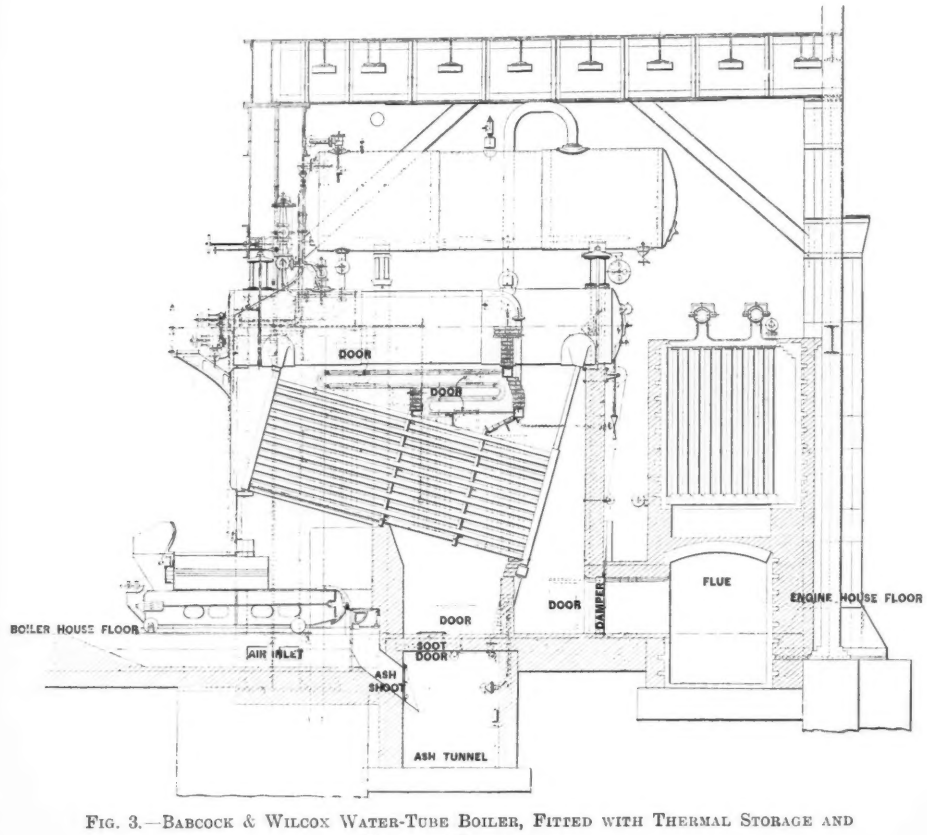


Fig. 3.—Babcock & Wilcox Water-Tube Boiler, Fitted with Thermal Storage and Internal Superheater.

Such drastic, though justifiable, treatment is rarely even considered in the case of compulsorily purchased plant, but were such businesslike methods uniformly adopted, after due consideration, less would be written about doubtful municipal enterprise, of which Marylebone's case, despite the hopeful view of its advising engineer, formed one of the most notable examples we can call to mind.

We welcome the commercial aptitude displayed thus far in the case in question, as also in the case of many other successful municipal undertakings, but it is impossible to close one's eyes to the many loop-holes which exist for mismanagement in such concerns, despite the very best efforts of the engineers entrusted with their control.

One reason for touching on such a controversial subject at an early stage in what would, if we followed our usual custom, be purely a technical description, lies in the important bearing which the *modus operandi* employed in this case may have on the future development of London's electricity supply areas.

The latter subject is pregnant with many possible solutions, none of which would please a certain section of the community better than the following of Marylebone's lead, despite the enormous risk involved.

Having obtained the necessary powers, the Council proceeded with the construction of a direct-current generating station on the bank of the Regent's Canal, together with a large amount of work in connection with the distributing network and sub-stations, to which reference will be made later on. In these days of prosaic station design, the arrangement adopted in connection with the Council's new plant is especially interesting, and constitutes a bold, and, we should imagine, successful departure from the well-worn groove of standard practice.

The station is a brick and steel structure, the north end of which abuts on the Regent's Canal, which will provide facilities for obtaining both coal and water; the southern end faces Richmond Street, and with the west side is of an ornamental character somewhat at variance with its present surroundings.

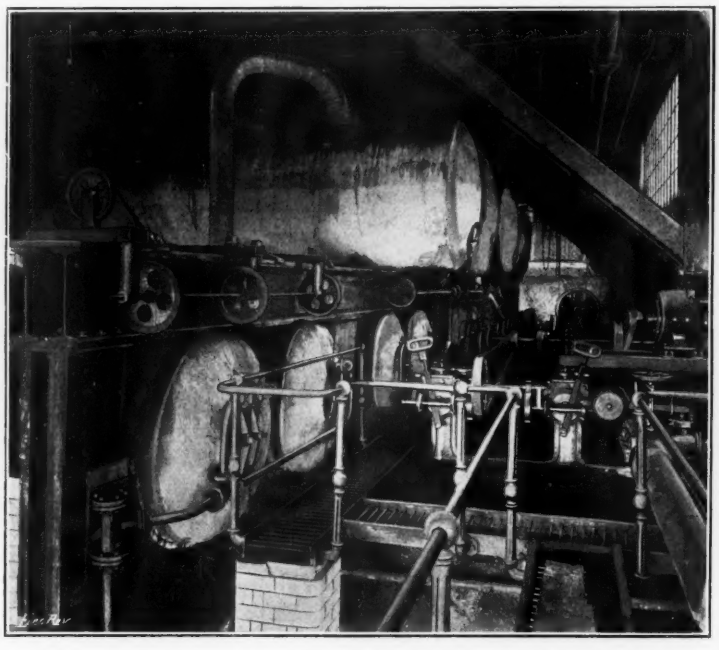


Fig. 4.—View Behind Boilers, showing Thermal Storage, Economisers and Induced Draught Fan at Base of Chimney.

Two views of the north end are given in figs. 1 and 6, which show the massive proportions of the boiler house structure,

also one side of the engine room with the cooling towers behind.

The buildings as a whole are built on a floating bed of concrete, and include a spacious engine room, a boiler house, over which is constructed coal bunkers and cooling towers, &c., a battery room, workshop, stores and offices; they are designed for 18,000 KW. of plant.

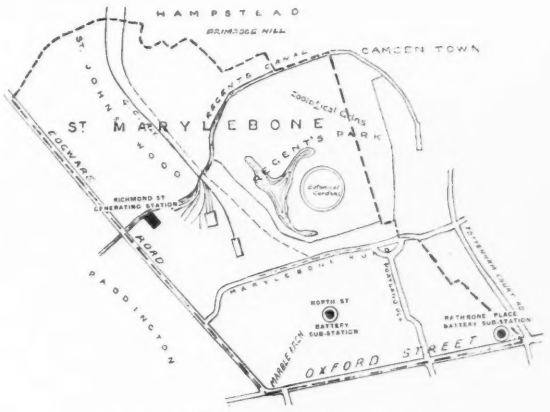


Fig. 5.—Plan of the Marylebone Area.

Fig. 6.—Exterior of the Generating Station, showing Engine Room.

The plant at present installed in the boiler house includes 10 Babcock & Wilcox boilers, shown in fig. 2, each having a normal evaporation of 18,000 lb. of water per hour at the working pressure of 200 lb. per sq. in. The boilers are erected in pairs, and every such pair is provided with a separately fired superheater of the Babcock & Wilcox type, shown in fig. 7, by which the temperature of the steam is raised to 500° F.; also one of the two boilers is fitted with two thermal storage vessels, the use of which enables the boiler unit so fitted to give an increased evaporation during peak loads, the evaporative capacity of the boiler being raised to approx. 25,000 lb. per hour. Every pair of boilers with its thermal storage and superheater forms an independent unit linked up to the main steam header by a 10-in. branch pipe, and space exists in the building for a further unit of the same size, but fitted with an internal superheater.

The arrangement outlined was, to some extent, followed by Mr. Arthur Wright at the Southwick power station at Brighton, the thermal storage being absent; the flexible control which it gives both in regard to quantity and quality of steam is an obvious advantage where sudden loads and steam turbines are prime factors. The whole of the boilers and superheaters are fitted with chain-grate stokers, which are operated from an overhead shaft driven in sections by electric motors.

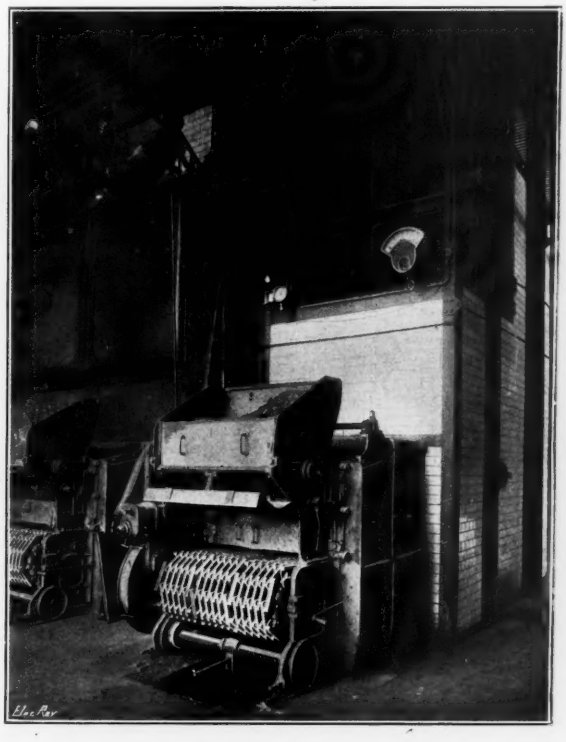


Fig. 7.—One of the Independent Superheaters in the Boiler House.

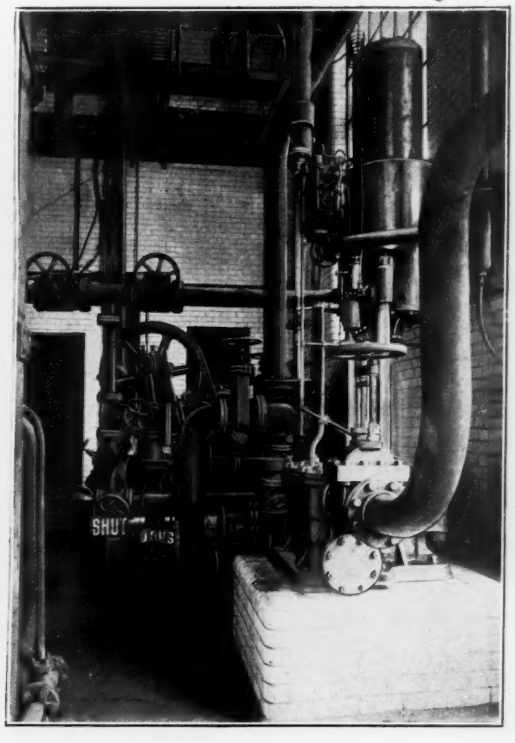


Fig. 8.—One of the Duplicate Feed Pump Installations in the Boiler House.

The boilers and pipes are mostly lagged with sectional magnesia; the valves and fittings are all of Hopkinson's make. Fig. 13 shows the arrangement of a boiler unit.

A coal bunker constructed in steel and concrete, with a capacity of 2,500 tons, is situated over the firing floor; from the bunker, coal is fed by gravity into the stoker hoppers,

through Ingrey travelling weighing machines, five of which (shown in fig. 2) are provided.

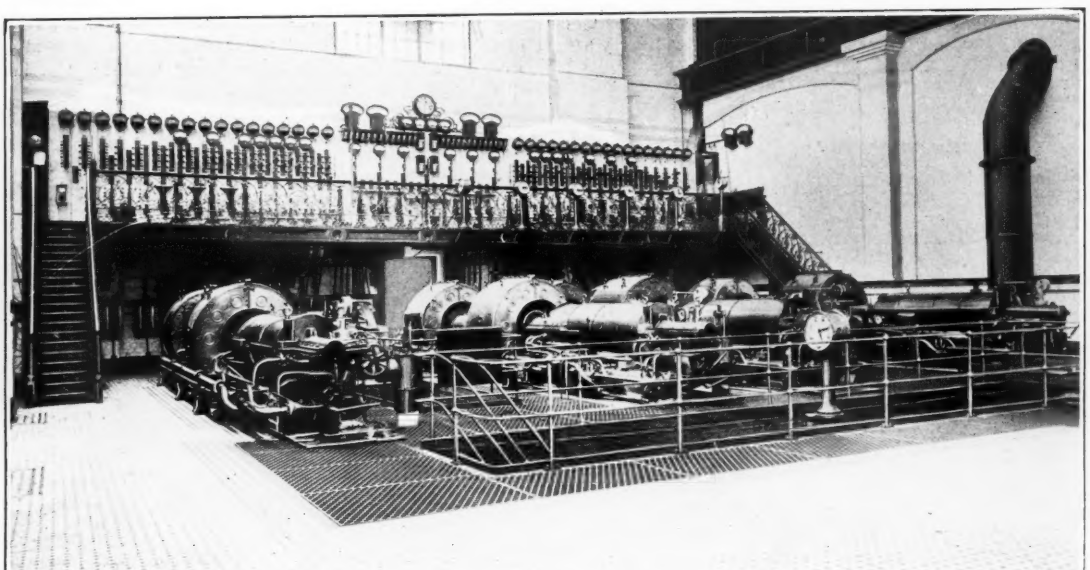


Fig. 9.—The North End of the Engine Room, showing the 500-kw. Units.

These machines are operated electrically; they register the exact weight of coal delivered to the boilers.

At the present time coal is carted to the Richmond Street end of the boiler house and there dumped into a hopper, from which a bucket elevator lifts it to the top of the building, depositing it on a Robins belt conveyor for distribution throughout the bunker. The ashes from the furnaces fall on to a tray conveyor working in a tunnel under the boilers, and are carried to the end of the building, and dumped into the coal elevator previously referred to; the latter lifts them into a reserve ash hopper at the end of the bunker, from which they are discharged into carts for removal.

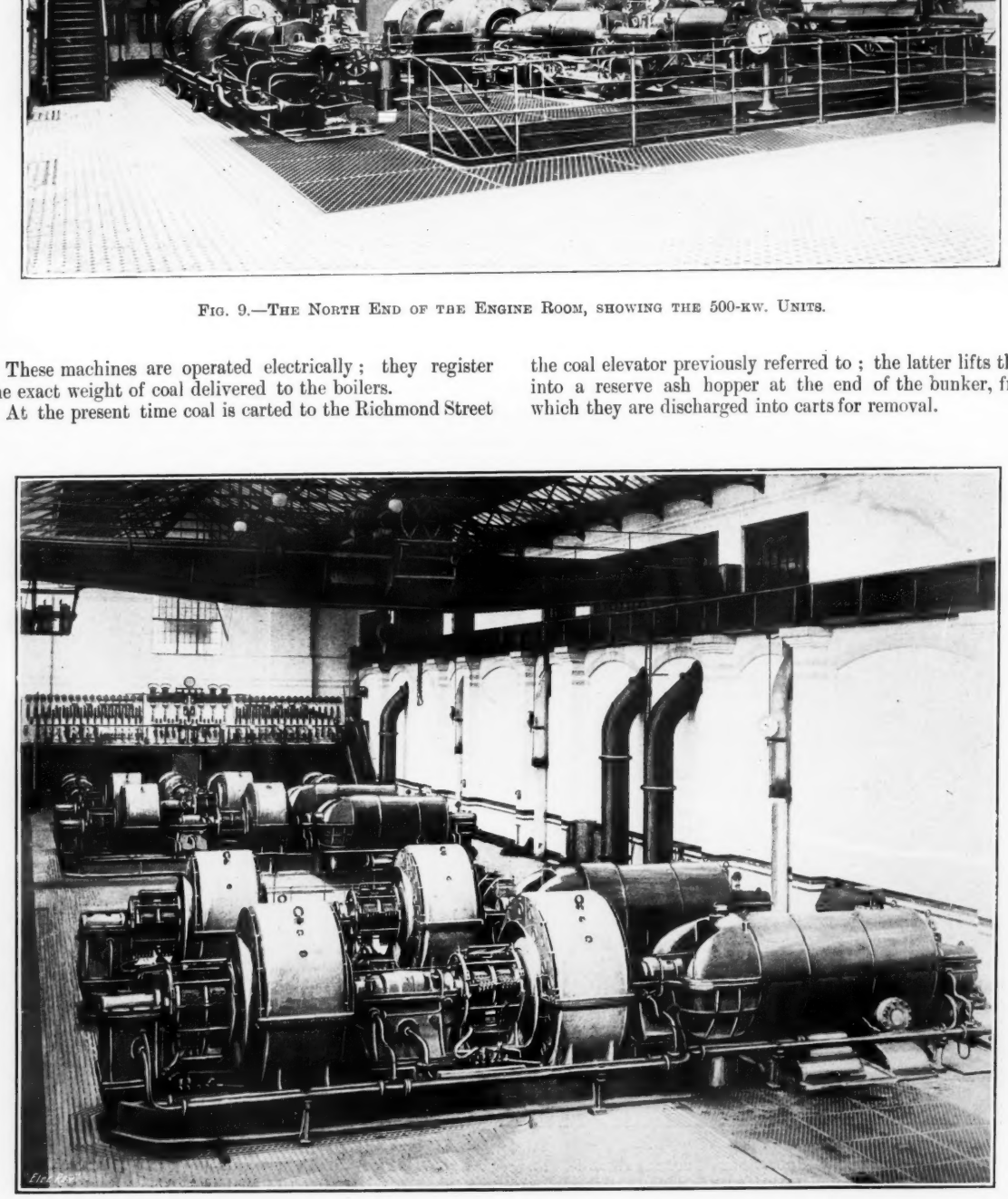


Fig. 10.—General View of the Turbo-Generating Plant, the 2,000-kw. Units in the Foreground.

As previously mentioned, one extremity of the boiler house abuts on the Regent's Canal, and coal and ash-elevating plant is provided at that end also. An electrical crane with a grab is provided for lifting coal from barges and dumping

it into the hopper of a bucket elevator, which discharges on to the Robins belt conveyor previously mentioned. The latter conveyor and the tray conveyor for ash handling are necessarily reversible; and a further ash bunker has been provided near the canal.

The whole of the boiler and conveyor plant was supplied by Messrs. Babcock and Wilcox.

The waste gases from the furnaces pass through four Green economisers, which are arranged behind the boilers and disposed on either side of two circular chimneys. Four induced draught plants are also provided between the economisers and chimneys. Fig. 4 shows an economiser with the induced draught fan behind, also thermal storage drums on the left.

The economisers contain in all 1,720 tubes, the scrapers in each section being driven by an electric motor; the usual by-pass flue is provided, in this case underneath the economisers.

The induced draught plants consist of 48 and 60 in. diameter fans driven by 33 and 65 H.P. motors, and are specified to deal with 50,000 and 100,000 cb. ft. of chimney gas per min., respectively.

The chimneys are 8 ft. diameter internally and 125 ft. high; they were built by the Alphons Custodis Co., and are circular in section above the boiler house roof level, where they rub shoulders with the cooling towers, to which we shall refer later.

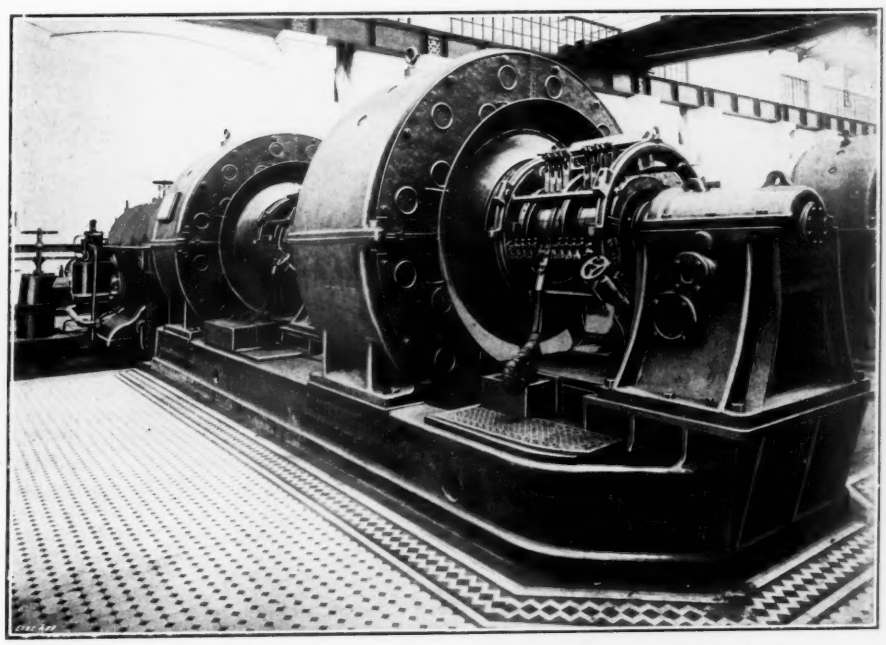


Fig. 11.—Generator End; 2,000-kw. Parsons Direct-Current Turbo-Units.

At either end of the boiler house is installed duplicate feed pump plant, each consisting of a Hall compound steam pump with a rated capacity of 10,000 gallons per hour, and a Simpson electrical three-throw plunger pump of 15,000 gallons per hour capacity, geared to a 35-H.P. 250-volt B.T.-H. motor.

Fig. 8 is a view of the feed pumps at the north-end of the boiler house, where also a steam-driven direct-acting artesian well pump, by A. C. Potter & Co., with a capacity of 10,000 gallons per hour, is situated. All the feed and circulating make-up water is at present obtained from the well, which is 500 ft. deep; the water being pumped into the cooling tower tanks situated on the roof of the boiler house. One tank is reserved for boiler feed purposes, and a Reisart water softener, also situated on the roof, deals with the make-up water supplied to this tank, which can further be supplemented from the public sources.

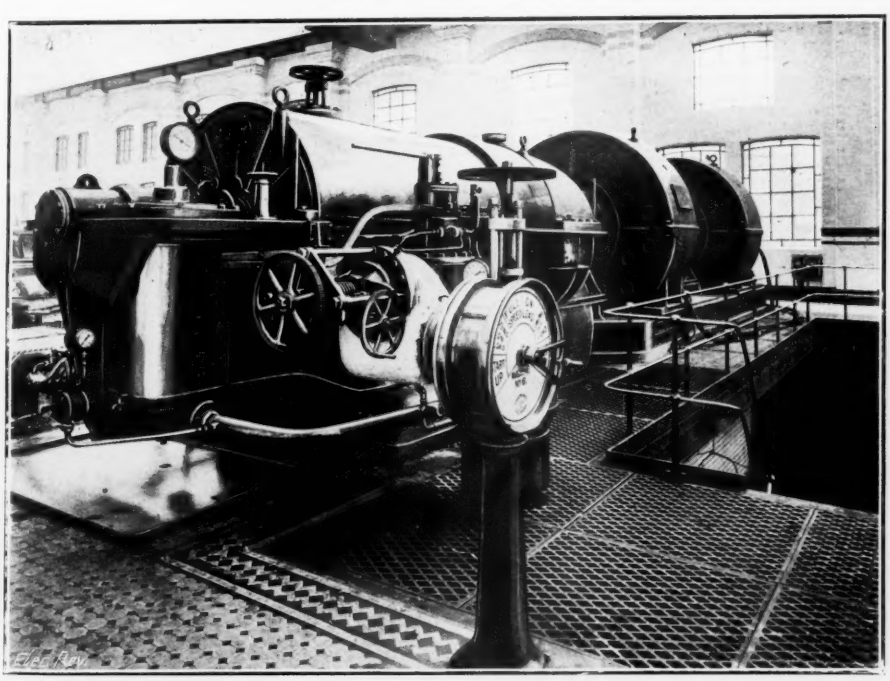


Fig. 12.—Steam End; 2,000-kw. Parsons Turbo-Generator Engine Room Telegraph in the Forefground.

Fig. 14 shows the situation of the cooling towers, with the water-softening plant on the right. Among other accessories indispensable in a modern boiler house may be mentioned the "ship type" telegraph, communicating with the switchboard; and the CO_2 recording apparatus.

Turning to the engine room, a view of which is given in fig. 10, the generating plant consists exclusively of turbo-generators by C. A. Parsons & Co., and includes what are, we believe, the largest direct-current sets of that kind built up to the present.

The engine room is well lighted and lined with crystopal glass tiles.

Two large switchboards for controlling the output are situated on galleries at either end.

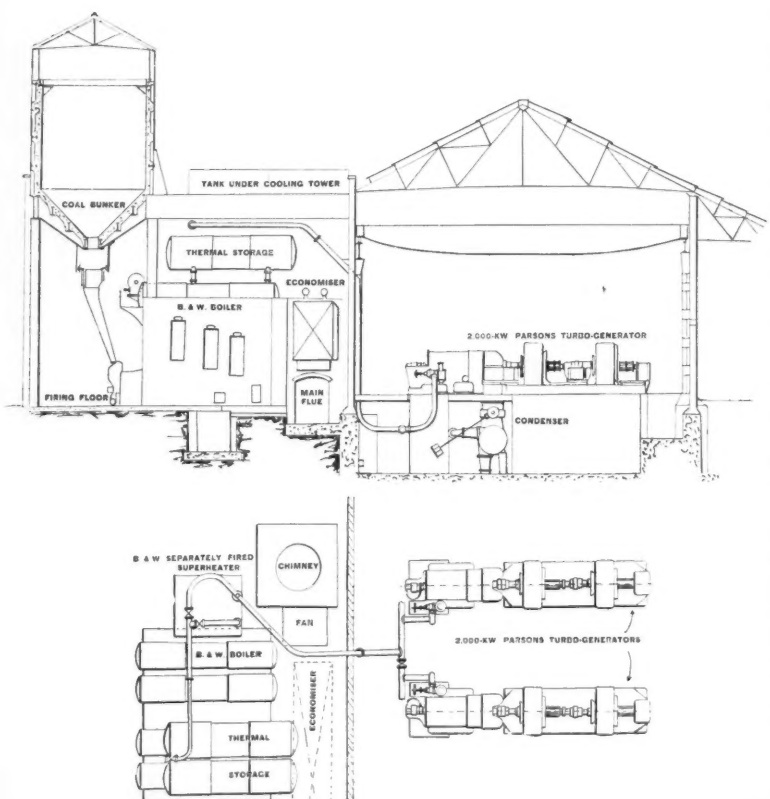


FIG. 13.—DIAGRAM SHOWING ARRANGEMENT OF A BOILER UNIT AND TURBO-GENERATORS.

tandem. Each generator is rated at 1,000 amperes at a pressure of 250 volts, and at a speed of 3,000 R.P.M.

The remaining units are each of 2,000 KW. capacity, the two 1,000-KW. generators, each being designed to give 2,000 amperes at 500 volts pressure, and at a speed of 1,200 R.P.M.

The generators follow, in construction, Messrs. Parsons' well-known practice, and are fitted with compensating windings and corrugated commutators with wire brushes.

For the 2,000-KW. sets, the steam consumption was guaranteed not to exceed, at full load, 20 lb. per KW.-hour measured on the switchboard with 100° F. superheat; for the 500-KW. sets, the steam consumption under the same conditions is 21 lb. per KW.-hour, deducting in both cases the energy taken by the auxiliaries.

The machines have a 25 per cent. overload for 1 hour, and a 50 per cent. overload momentarily, and we understand that unofficial tests show a very low steam consumption.

Beneath the engine-room is situated a spacious basement, which contains surface condensing plant, and the electrical connections between the various machines and switchgear, &c. The four smaller turbine units are arranged to exhaust into two surface condensers, the latter being coupled up to an exhaust on either side, and in each case being complete with motor-driven air and circulating pumps. The larger 2,000 KW. units exhaust into a condenser placed immediately under the exhaust chamber of the turbine: the Parsons vacuum augmentor is fitted to each condenser.

The air pumps are in each case of

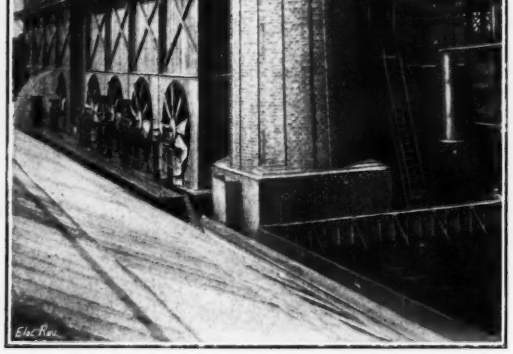


FIG. 14.—THE KLEIN COOLING TOWERS ON THE ROOF OF THE BOILER HOUSE.

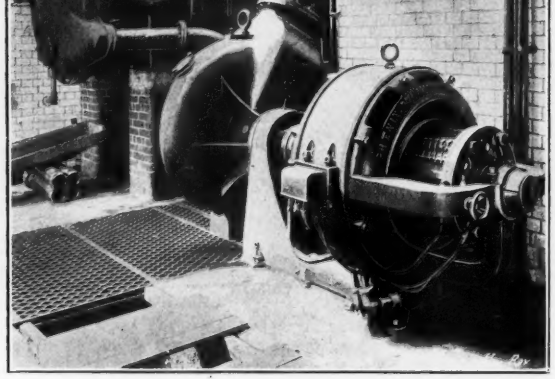


FIG. 15.—SURFACE CONDENSER AND CIRCULATING PUMP, 2,000-KW. UNIT.

Immediately under the north board, four 500-KW. turbo-units are installed, as shown in fig. 9, these in common with the larger sets comprise two D.C. generators mounted in

the three-throw type, with an additional hot-well force pump coupled to the crankshaft; they are driven through single reduction gears by 10 B.H.P. and 17 B.H.P. Phœnix

motors. The larger air pumps and motors, together with their switchgear, find a convenient location in open portions of the basement, which are railed off between alternate pairs of the 2,000 KW. units.

Fig. 17 indicates the convenient arrangement of the condensing plant, the auxiliary switchgear in the rear includes one starting board for each air and centrifugal pump. The circulating pumps are of the "Bon Accord" centrifugal type, direct coupled to 62-B.H.P. and 120-B.H.P. six-pole Phœnix motors in the two sizes of plant respectively.

Messrs. C. A. Parsons & Co. were contractors for the whole of the turbo-generating plant and condensers, &c. The cooling towers, previously mentioned and shown in fig. 14, are each designed to cool 440,000 gals. of water per hour, and are of the Klein type, fitted with eight 32-H.P. fans driven by Mather & Platt motors. With a view to supplementing the make-up water obtained from the artesian well and used for circulating purposes, arrangements are nearly completed for drawing a supply of condensing water from the Regent's Canal.

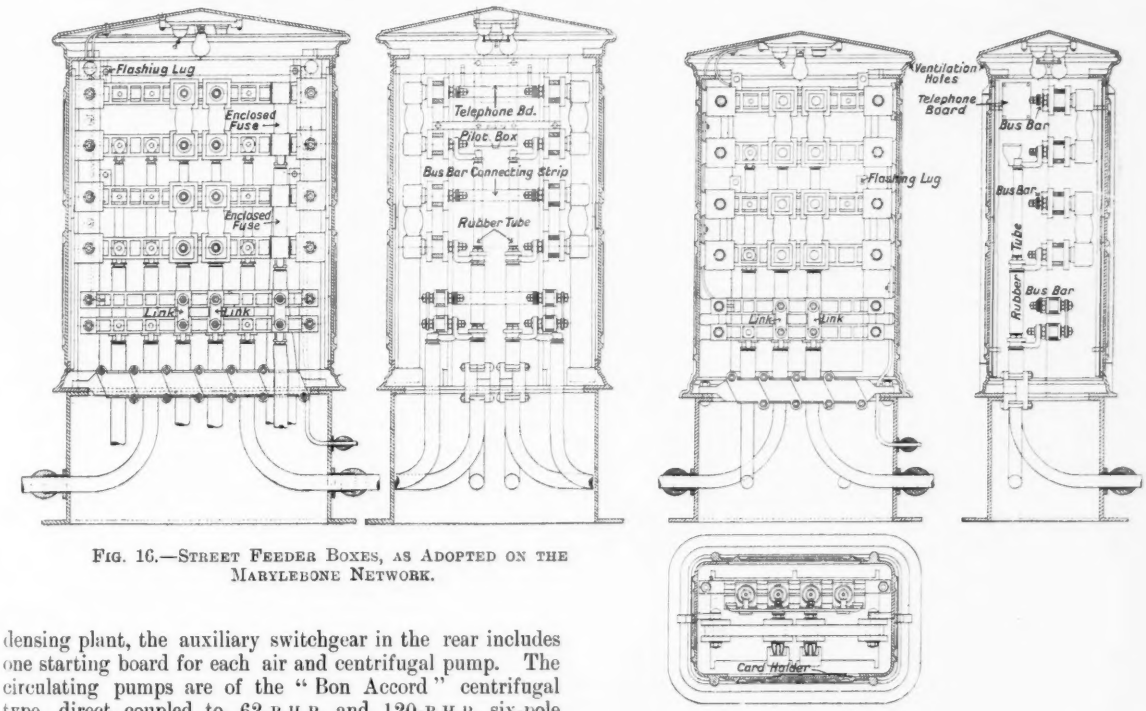


FIG. 16.—STREET FEEDER BOXES, AS ADOPTED ON THE MARYLEBONE NETWORK.

Alternative atmospheric exhausts through automatic valves are provided to each condensing plant, and lead into two steel uptakes at the side of the two main chimneys.

The engine room is spanned by a four-motor electric travelling crane, supplied by Messrs. C. & A. Musker, Ltd., and capable of lifting 20 tons.

The workshop (equipped with tools by Messrs. Hobdell, Way & Co.), stores, battery room, &c., occupy a bay on the western side of the engine room. The battery, which is utilised for station work only—such as lighting and excitation—consists of 250 cells of the E.P.S. Co.'s O.K. type, with a capacity of 500 ampere-hours. In connection with the battery a booster of Messrs. Siemens' make (seen in fig. 18), to deal with 500 amps. at 100 volts, is installed under the North Switchboard Gallery.

As previously stated, the station is designed for direct current supply on the three-wire system, with 480 volts pressure across the outers. Energy is supplied at 240 volts for lighting, and at 480 volts pressure for power.

Two switchboards are provided, each divided into three sections—positive, neutral and negative; the panels are of white marble, and the galleries of fireproof construction throughout, with glass tile floors.

Underneath the galleries are fixed the feeder fuse panels and the generator watt-hour meters, the latter of the Aron make.

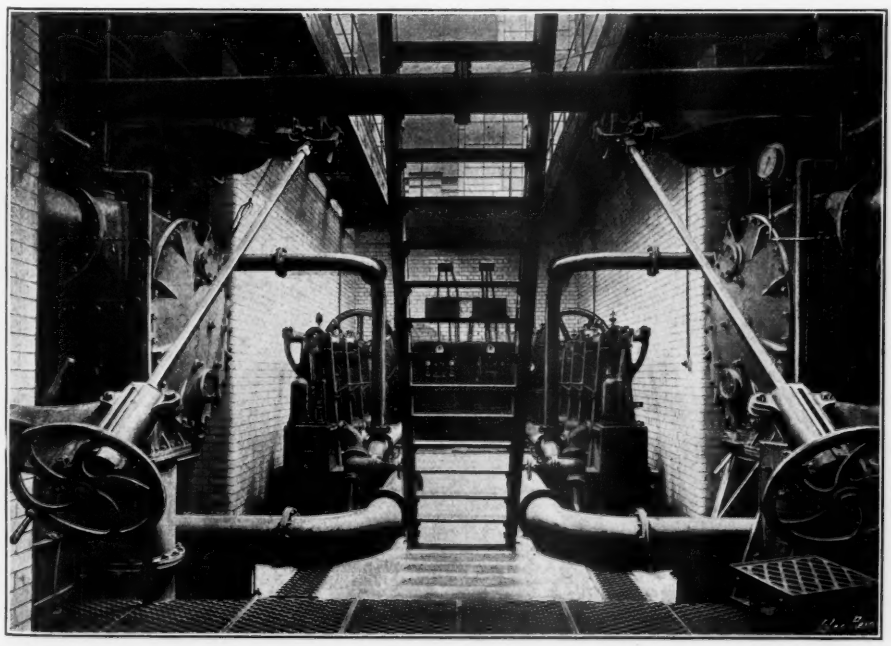


FIG. 17.—VIEW OF OPEN BASEMENT, SHOWING ARRANGEMENT OF AIR PUMPS, CONDENSERS, &C., BETWEEN THE LARGE TURBO-GENERATORS.

Four main bus-bars run horizontally along the back of the positive and negative sections; on the front of the panels are vertical bars enabling any machine or feeder to be plugged on to any horizontal bar, and it is thus possible to run four different pressures at as many feeding points from each board.

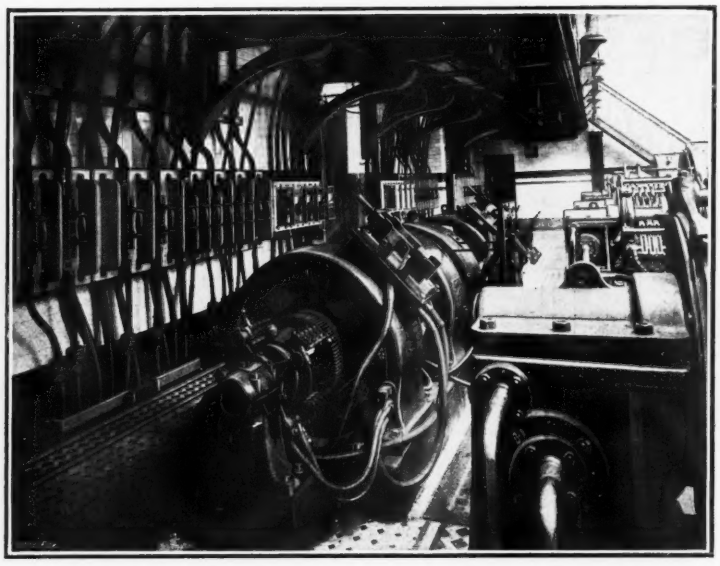


Fig. 18.—View under the North Switchboard, showing the Feeder Fuses, Battery Booster, &c.

This arrangement also provides for boosting up the pressure of any feeder or group of feeders, as well as for charging the batteries; it obviates any chance of disturbance to the general supply due to the breakdown of any one feeder, and further, the distribution network can be split up for testing purposes, &c. On the north board, shown in fig. 19, seven machine panels control three 2,000-kw. units, and the four 500-kw. double units, which can be used as balancers; further panels are provided for two batteries, one across each side of the three-wire system—and the necessary boosters for charging, &c. Each main generator has a reverse current circuit-breaker on one pole and a quick-break knife switch with separate hinge on the other. The field circuits are arranged either for self or separate excitation in order that the machines may run at different voltages on the various bus-bars when required. In addition, 17 positive, 17 negative, and six neutral feeder panels are provided; the feeders are controlled by single-pole quick-break knife switches and fuses, the latter being mounted on separate panels below the gallery, as shown in fig. 18.

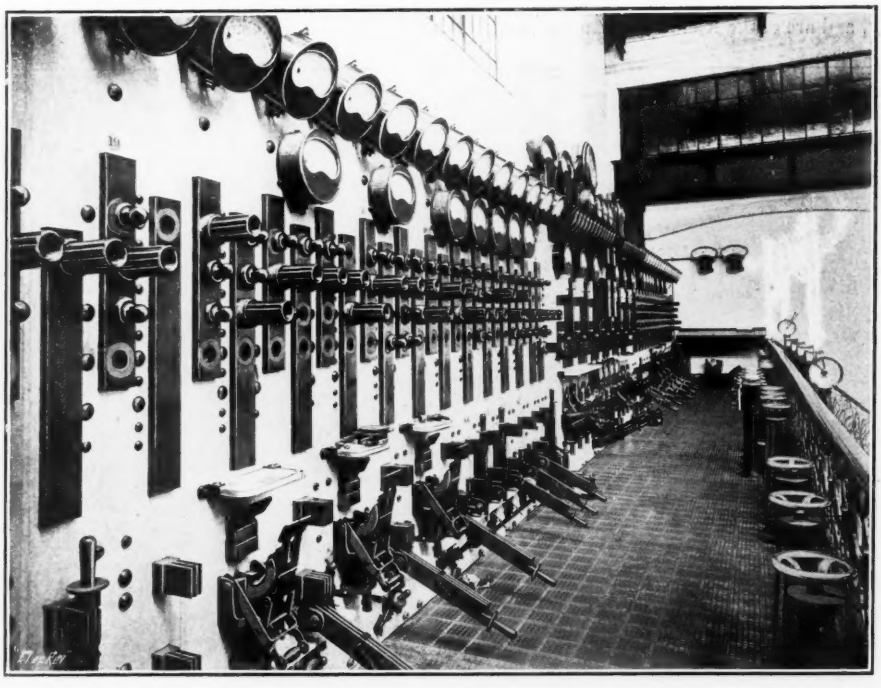


Fig. 19.—The North Switchboard, showing the Elliott Direct-Current Switchgear.

The central portion of the board is reserved for the batteries, neutral bus-bar and neutral feeders.

The south board is practically a duplicate of the above, with the exception of the neutral section.

There are in all 28 positive feeders, 28 negative feeders, six neutral feeders and two power feeders.

A very complete "ship" telegraph installation provides communication between the switchboard and the engine and boiler house staffs.

In addition to the two main boards and feeder fuse panels, all the voltmeter pilot wires are brought back to a separate small fuseboard mounted on the wall at the back of the main board.

Among the special switchgear may be mentioned a complete three-wire testing panel, on which is mounted a middle-wire earth recording ammeter, Groves's ohmmeter, "flashing" switches, fuses, &c., for testing and locating faults on the system.

On the two boards there are something like 200 instruments of Messrs. Elliott Bros.' well-known moving-coil type—the ammeters being of the round pattern, and the voltmeters of the edge-wise pattern. The switchgear, instruments, &c., were made and erected complete by Messrs. Elliott Bros.

From the foregoing it will be apparent that the Borough Council commences the business of electricity supply with a typically modern plant, which, so far as its chaotic state up to now has permitted the engineers to ascertain, bids fair to prove of high commercial efficiency.

To be strictly accurate, of course, the Council's first essay as an electricity supplier was with energy purchased in bulk from its predecessor in the area, and some account of the difficulties of the transition stage, during which the first and second generating units in the Council's station were started up, before the building was half completed, would form interesting reading, did space permit.

In connection with the distribution system, also, a great deal of work has been carried out.

In the first place, a gradual change-over of the consumers' pressures has been made, the Metropolitan Co.'s original services being arranged for 100 and 200 volts, alternating and direct current, on the three-wire system.

The amount of work here involved can be gauged from the fact that of the 7,000 consumers connected up, all have now been dealt with. Then, again, the old generating stations at Manchester Square and Rathbone Place have been turned into battery sub-stations, each with an equipment consisting of a 3,000 amp.-hour battery with the necessary switchgear and booster-balancers; of the latter, one just started was supplied by the Lancashire Dynamo Co., and is designed to give 4,500 amps. at 50 volts for short intervals, and 1,000 amps. at 100 volts continuously.

Altogether 24 feeders, including eight of ·5 sq. in. and 16 of 1 sq. in. section, have been laid, for connecting the generating station with standard feeder pillar boxes, of the type shown in fig. 16. From these, sub-feeders radiate to various points on the distributing network. These feeder pillars have been extensively used throughout the area, 10 12-way, 11 6-way, and 102 3 and 4-way pillars having been employed.

The St. Helens Cable Co. carried out the cable work, the cables being of the paper-insulated, lead-covered and armoured type, laid direct; this company also supplied the feeder pillars.

It is anticipated that the supply for public and private lighting and power will exceed 7 million units during the year ending March next. The public lighting has only recently been introduced in the area, and the 86 flame arcs, fitted in pairs on standards down the centre of Oxford Street, form an example in efficient street illumination well worth imitating elsewhere in the metropolis.

In conclusion, we are indebted to Mr. Arthur Wright for granting us facilities for preparing this article; our acknowledgments are also due to Mr. T. G. Otley (of Mr. Wright's staff), Mr. F. A. Wilkinson, resident engineer to the Marylebone undertaking, and to Mr. T. R. Richardson, superintendent of the generating station described above.

CONTRACTS CLOSED.

(*Concluded from page* 102.)

Cauvery Falls, India.—The contract for the hydraulic power plant required for the third installation in this power station, which supplies power to the Mysore Gold Fields, has been placed with Messrs. James Gordon & Co., of Knightrider Street, London. It includes a special design of Pelton wheel, to develop 2,700 B.H.P. under a fall of 380 ft., for direct coupling to an alternating-current generator, a sensitive quick-acting governor and heavy riveted steel pipe line, 4 ft. diameter, with expansion joints, relief valve, &c. This is the first order for hydraulic plant for this station obtained by an English firm, all the existing plant being by Continental makers.

Cornwall.—The South-West Cornwall Mines, Ltd., have placed an order with Messrs. Johnson & Phillips, Ltd., for the supply and erection of gas plant, engines, dynamos, switchboard, electrical pumps and plant.

Devonport.—Messrs. Cowans, Sheldon & Co., Ltd., have received from the Admiralty orders for one 20-ton and two 30-ton steam travelling cranes, two 75-ton electric Fairbairn cranes, and one 160-ton electric Hammer crane for Devonport Dockyard.

Leyton.—The Lamson Paragon Supply Co., Ltd., have accepted the tender of Messrs. Johnson & Phillips, Ltd., for all electrical plant for the company's factory, including dynamos, motors and switchboard.

London.—BERMONDSEY.—The B.C. has accepted a tender of Messrs. Johnson & Phillips for cable required in connection with the electricity undertaking.

The following tenders were submitted for 450 yards of troughing and covers:—

Doulton & Co., Ltd. (accepted).—Troughs, U-shape, 4½d. per yard, £7 14s. 8d.; covers, 3½d. per yard, £6 11s. 3d.; bridges (680), 8s. 6d. per gross, £2 0s. 2d.; total £16 6s. 1d.

Johnson & Phillips.—Troughs, covers and bridges complete (680), 1s. 3d. per yard, total £28 2s. 6d.

STEPNEY.—The B.C. has received the following quotations for 50 tons of moulded pitch for the electricity undertaking:—

	Per ton.
Thomas Crow & Sons .. .. .. (accepted)	32s.
South Metropolitan Gas Co.	34s.
Forbes, Abbott & Lennard, Ltd.	35s.
Rowland Carr & Co.	37s.

FULHAM.—The B.C. has accepted the quotation of J. S. Gilman and Co. to supply 500 tons of nutty slack from the West Hallam pits, at 11s. 6d. per ton.

Lowestoft.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for a boiler, pipe-work, &c., at £993, and that of the Horsfall Destructor Co., Ltd., for the extension of the destructor, at £1,030.

Manchester.—A tender by Messrs. Willans & Robinson, Ltd., of Rugby, for the supply and erection (on foundations to be provided by the Corporation at the Stuart Street generating station) of a 6,000-KW. turbo-generator, comprising a Willans turbine, a Siemens alternator, and condensing plant by Richardsons, Westgarth & Co., Ltd., for the sum of £20,777, has been accepted by the Electricity Committee. The British Westinghouse Co.'s tender for high and low tension switchboards for Dickinson Street sub-station has also been accepted.

Redditch.—The U.D.C. has accepted the tender of Messrs. Heenan & Froude, Manchester, for the supply of a refuse destructor, at £2,174.

Sydney (N.S.W.).—The tender of Mr. R. B. Hungerford (Western Electric Co.) has been accepted for sections of the common battery switchboard and accessories, at the Telephone Exchange. The amount is £4,312, which, with instruments and extras, is brought up to a total of £5,726. When complete the exchange will provide for 1,080 additional subscribers. A metallic circuit will be provided and a new section installed almost immediately.

FORTHCOMING EVENTS.

To-day's Events (Friday, January 18th).—At 8 p.m. Institution of Mechanical Engineers. Adjourned Discussion on "Lighting of Railway Premises: Indoor and Outdoor," by Mr. H. Fowler. Prof. H. C. H. Carpenter and Mr. C. A. Edwards "On the Properties of the Alloys of Aluminium and Copper." (Eighth Report to the Alloys Research Committee.)

At 9 a.m. Royal Institution. Sir Andrew Noble, Bart., on "Fifty Years of Explosives."

At 9.30 p.m. Electrical Engineers' Ball at Hotel Cecil, W.C.

Saturday, January 19th.—At 10 a.m. Institution of Electrical Engineers (London Students). Visit to the Silvertown Works of the I.R., G.P. and Telegraph Works Co., Ltd.

Institution of Electrical Engineers (Manchester Students). Visit to Messrs. Dick, Kerr & Co.'s Works at Preston.

At 2.30 p.m. Junior Institution of Engineers. Visit to the Royal Naval College, Greenwich, to inspect the new Engineering Laboratory.

Monday, January 21st.—At 7 p.m. Armstrong College Engineering Society. Mr. E. J. MacWilliams on "Electricity Applied to Mining."

Tuesday, January 22nd.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. C. E. Douglas on "Gas Power Plants."

Thursday, January 24th.—At 7.15 p.m. Institution of Electrical Engineers (Leeds). Mr. H. Campbell on "Gas Engines and Suction Gas Plants."

At 8 p.m. Institution of Electrical Engineers (London). Mr. C. C. Paterson on "Investigations on Light Standards and the Present Condition of the High-Voltage Glow Lamp."

Friday, January 25th. At 5 p.m. Physical Society. Mr. W. A. Scoble on "The Strength and Behaviour of Brittle Materials under Combined Stress." Mr. F. Twyman on "A Spectrophotometer." Mr. K. J. Tarrant on "Photographs of Electric Sparks."

At 7 p.m. Armstrong College Engineering Society. Mr. J. C. Browne on "Electric Traction."

At 8 p.m. Institution of Civil Engineers (Students). Mr. C. A. Ablett on "Alternating-Current Commutator Meters."

North-East Coast Institution of Engineers and Shipbuilders. Meeting.

Saturday, January 26th. Northampton Institute Engineering Society. Visit to the Gas Light and Coke Co.'s works, Beckton.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, January 21st.—"A" Company, recruits' infantry drill, 6 p.m. technical instruction, 7 p.m.

Tuesday, January 22nd.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m. Medical examination recruits, 6.30 to 8 p.m.

Wednesday, January 23rd.—N.C.O.'s mess meeting (committee), 8 p.m.

Thursday, January 24th.—"C" Company, technical instruction, 7 p.m.

Friday, January 25th.—"D" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Saturday, January 26th.—"B" Company, training at Gravesend.

J. H. S. PHILLIPS, Captain,
For O.C.E.E.R.E. (V.).

C.T.C. Old Students' Association. — The annual general meeting and dinner of the Central Technical College Old Students' Association is to be held at the Trocadero Restaurant on Saturday, February 23rd, at 7.15 p.m. This is the tenth anniversary of the Association, and a record attendance is anticipated. Applications for tickets should be sent to Mr. R. J. Caldwell, hon. sec. of the Dinner Committee, before February 9th.

NOTES.

Carbon-Filament Glow Lamps.—The specification just issued by the Engineering Standards Committee (Crosby Lockwood, price 5s. net) provides that the British light standard shall be the 10-c.p. Vernon-Harcourt pentane lamp at the National Physical Laboratory, from which carbon-filament secondary standards shall be derived. The useful life of a lamp is completed when the mean horizontal candle-power has dropped 20 per cent. Four classes of standard lamps are recognised, having lives of 400 and 800 hours respectively, and made for 110 and 220 volts; these are distinguished by reference letters, which also indicate the standard efficiencies. Thus, for 16-c.p. lamps, A represents a 400-hour 50-watt lamp for 110 volts; B a 400-hour 60-watt lamp for 220 volts; C an 800-hour 56-watt lamp for 110 volts; and D an 800-hour 66-watt lamp for 220 volts. The reference letter (in a circle), voltage and M.H.C.P. are to be marked on each lamp bulb, with the name or trade-mark of the manufacturer.

Tests are prescribed for mechanical defects, insulation resistance and vacuum, as well as for initial candle-power, efficiency and total watts; the candle-power is to be determined at standard pressure, while the lamp is revolving at 200 R.P.M. about a vertical axis. The average limits between which the results must fall are 8 per cent. for the candle-power and 5 per cent. for the total watts, but individual lamps are allowed about 60 per cent. greater latitude; the watts per M.H.C.P. are limited to ± 16 per cent. from the standard. Life tests are to be carried out on a circuit whose voltage is never more than ½ per cent. above normal, the pressure being adjusted at the start so that the lamp is burning at its standard efficiency, and the average total candle-power hours during the useful life must not fall below 90 per cent. of the standard figures. The ratio of mean spherical to mean horizontal candle-power is to be not less than 0·8.

The standard efficiencies for 8 and 16-c.p. lamps are as follows:—

Class.	Life.	Volts.	c.p.	Watts per c.p.
A	400 hours	110	8	3·25
			16	3·10
B	400 „	220	8	3·90
			16	3·70
C	800 „	110	8	3·75
			16	3·50
D	800 „	220	8	4·50
			16	4·10

Limit gauges are provided for testing lamp cap dimens'ons.

Fatality.—In the City Coroner's Court, on Friday, Mr. F. Danford Thomas held an inquest with reference to the death of Frank Wm. Moore, aged 36 years, an installation inspector in the employ of the City of London Electric Supply Co., Ltd., and lately living at East Dulwich Grove, Peckham, S.E. Frank Joseph Macey, chief engineer in the electric lighting section at the Commercial Sale Rooms, Mincing Lane, E.C., said that three days prior to the deceased's death two men called at the sale rooms to make up an estimate, this being a private generating station. On Tuesday last the deceased came officially to deliver this estimate, and whilst there witness asked him what it would cost to run an exhaust fan electrically. They walked over towards the fans in use at the present time, which were in motion, but witness did not imagine for one moment that he would go near them, as he knew the danger. The deceased knew every hole and corner of the room in which the electrical plant was, and he knew that no one could go near the fans without a terrible danger to life. Witness turned round to see what the load was on the switchboard when he heard a sound like the crushing of a hat. He thought a bolt or a belt had gone wrong, so turned off the current, and on going to see what was the matter was horrified to find the deceased lying on the stone at the side of the fan shockingly mangled. So far as witness could make out he had attempted to get over the rail at the side of the fan with the idea of squeezing past the ten inches of space between the fan and the wall and had been caught by the belt and whirled round and round to his death. It was only the fact that the deceased knew so much of electrical work that could have caused him to take such an awful risk. So great had been the force with which the deceased had been dashed against the stones that they were smashed in many places. The fan was fixed on the edge of the wheel race, and witness would never have attempted to go past the fan whilst in motion, and would certainly never have allowed anyone else to do so had he been able to prevent it.

Mr. James Parker Buck, chief inspector, said his opinion was that the deceased was going to look to find a suitable place to fix a motor for the working of the fan by electricity. There was no doubt he ran a terrible risk.

Dr. Kaufmann, of Dunster House, said that death was due to the terrible injuries, the deceased's left leg having been torn off and his skull fractured in many places.

The Coroner said that the curious part of the case appeared to be the fact that it was the deceased's knowledge of his business which caused him to be indifferent and to run the risk, where a layman would not have attempted such a thing.

The jury returned a verdict of "Accidental death."

Electrical Volunteers.—The *Times* says it is intimated that the establishment of the Submarine Miners and Electrical Engineers (Vols.) has been fixed at a total of 66 officers and 1,218 men.

X-Rays as a Hair Restorer.—In the current issue of the *Archives d'Electricité Médicale*, Prof. A. Imbert and M. H. Marqués confirm the observation recently noted, that exposure to X-rays results in the restoration of its normal hue to white hair. One of the authors, who has been engaged in X-ray work since 1896, and whose hair and beard were almost completely white, found that their colour returned and became even darker than the original tint; similarly when an elderly patient was under treatment for lupus, part of his hair was exposed to the rays, and fell off; it returned, however, almost completely black over the region affected, and has since retained its colour. These and other facts have convinced the authors of both the reality and the durability of the effects obtained, though they are unable to put forward a satisfactory explanation of the phenomenon. Those of our readers, therefore, who rejoice in the possession of silver locks had better steer clear of the X-rays.

Direction der Disconto-Gesellschaft v. Bruce Peebles & Co., Ltd.—Lord Mackenzie, in the Court of Session on 8th inst., closed the record in an action instituted by the Direction der Disconto-Gesellschaft, London and Berlin, against Messrs. Bruce Peebles & Co., Ltd., electrical engineers, East Pilton, Edinburgh, to recover £4,000 contained in a bill of exchange dated May 9th, 1906, payable six months after date, drawn by and to be placed to account of Messrs. Ganz & Co., Budapest, and accepted by the defenders on May 16th. The pursuers are now holders of the bill. At maturity (says a report in the *Edinburgh Evening Dispatch*) the bill was presented in Edinburgh, but, acting on the instructions of the defenders, the bank refused payment. The defenders explain that early in 1904 they contracted for an electric railway in Canada for the Canadian Electric Traction Co., and with Ganz & Co. for certain plant which that firm had invented or patented. They say that the system was defective, and that loss to the extent of over £4,000 has been incurred, for which they hold Ganz & Co. liable. Before the defenders knew how the system was to turn out they had granted the bill, and they plead that they are entitled to absolvitor in respect of the failure of the consideration given by Ganz & Co.

Steam Turbines for the Corporation of Bristol.—We have received the following remarkable communication, too late for insertion in our "Correspondence" columns:—

"Dear Sirs,—For the benefit of those who consider that manufacturers in this country are not suffering from want of Protection, attention might be drawn to a contract which the above Corporation have entered into with the *British* Westinghouse Co. for the supply of a 3,000-kw. steam turbine. The order for the turbine in question is being executed in the United States of America, and this in spite of several manufacturers in this country being well able to meet the requirements of the Corporation in this direction.

"It is surely to be regretted, in view of the unsatisfactory condition of trade in this country (Board of Trade returns notwithstanding), that one of our leading public bodies should allow a contract of this nature to be executed abroad, when shops at home are largely empty for want of orders. And it can scarcely be argued—even by those who usually consider that foreign-made productions must necessarily be superior—that steam turbines built in America have surpassed the best this country can produce.—PROTECTIONIST."

We sincerely trust that there is some mistake in our correspondent's information.

Appointments Vacant.—Car-shed foreman for Stockport Corporation (£175); assistant electrical engineer for Bradford Corporation (£250).

Institution Notes.—JUNIOR INSTITUTION OF ENGINEERS.—At a meeting on Wednesday evening last, Dr. H. S Hele-Shaw lectured on "Stream Lines and their Application to Engineering Problems."

SOCIETY OF ARTS.—On the 16th inst., the discussion on Mr. J. W. Gordon's paper "Patent Law Reform" was resumed.

The Jamaica Earthquake and the Cable Companies.—According to the *Daily Telegraph*, one cable line remains open to Jamaica. The West India and Panama Telegraph Co. has its cable intact to Holland Bay at the west end of the island, and its overland line is in good order as far as Bull Bay about seven miles from Kingston. From this point messages are carried to and from the ill-fated city by buggy. Of course, there is delay, but the work is being carried on as expeditiously as could be expected in the circumstances. The company received the following cablegram on Wednesday:—

"Through cable to Colon and direct West India cable interrupted. W.I. and P.T. Co. will use every effort to open for traffic, and expect to do so to-day (Wednesday). Shocks of earthquake are continuing, and everybody is camping out. Cannot work telegraph from Kingston, but can seven or eight miles out, and send to and from Kingston by road. Lines perfectly clear to rest of West Indies."

The Direct West India Co.'s offices and outfit at Kingston, Jamaica, were completely destroyed by the earthquake which occurred at that place at 3.30 p.m., on the 14th inst. Their cable is also interrupted close to the hut, and local efforts are being made to put through. One employé, a Jamaican, was badly injured; all other employés are safe and well.

Receiver Appointed.—On the petition of a debenture-holder, Mr. Herbert J. Page, of Messrs. Annan Dexter & Co., 21, Ironmonger Lane, E.C., has been appointed receiver in *re* Lionel Robinson & Co., Ltd., of Ferry Works, Thames Ditton.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—Owing to the resignation of Mr. R. E. Heygate, the following appointments have been made at the Dover Electricity Works:—Mr. H. L. OSBORNE to the post of senior charge engineer, Mr. H. BROWNSCOMBE to second engineer, and Mr. J. E. DUDGEON to third engineer.

The Launceston (Tasmania) City Council has accepted the resignation of Mr. CORIS, the city electrical engineer, who had threatened to resign if he were not allowed unrestricted private practice, together with an increase of salary to £600. Mr. Coris has been retained as consulting electrical engineer at a fee of £100 per annum, and a scheme is being prepared for the reorganisation of the department.

By 15 votes to 11, Warrington T.C. has referred back to the Electricity and Tramways Committee the recommendation to increase the salary of Mr. MATHIAS, electrical engineer, from £300 to £350 per annum, and that he be allowed to have two pupils.

The Electricity Committee of Rochdale T.C. has recommended that the salary of the electrical engineer (Mr. C. C. ATCHISON) be increased from £300 to £350 per annum.

Tramway Officials.—The Sheffield T.C. has been recommended to increase the salary of Mr. FEARNLEY, tramways manager, by £100 a year.

The employés of the Pontypridd U.D.C. tramway department have presented a silver cigarette case, match box and cigarette holder to Mr. J. E. TEASDEL, the manager, and Mrs. Teasdel with silver serviette rings.

General. — Mr. SIDNEY WELLS, Principal of the Battersea Polytechnic, has accepted the position of Director-General of the newly created Department of Agriculture and Technical Education in Egypt, which has been formed to develop, organise and control technical education and institutions to keep pace with the rapidly growing industrial needs of the country. Mr. Wells has been head of the Polytechnic at Battersea since before its opening in January, 1894, having previously been senior assistant lecturer in the Engineering Department of the University of Leeds. In earlier days he was well known to young engineers as the founder, and for five years Chairman of the Junior Instutution of Engineers, and in recent years he has been a member, and is at present the secretary, of the Faculty of Engineering of London University and of the Board of Studies in Civil and Mechanical Engineering, of which he was for some years the secretary. He has also been for some time a member of the Consultative Committee of the Board of Education, of the Teachers' Registration Council, of the City and Guilds Examinations Board, and hon. secretary of the Association of Technical Institutions.

Mr. F. B. SINCLAIR has resigned his position as manager of the Sheffield branch office of the British Westinghouse Electrical Manufacturing Co., in order to take up an appointment with Messrs. Bruce Peebles & Co., as manager of their Newcastle office, Pape's Buildings, Neville Street, Newcastle-on-Tyne. Mr. Sinclair took up his new duties on January 14th.

Obituary.—We deeply regret to notice that the death-roll consequent upon last Monday's terrible earthquake in Jamaica includes the name of Sir JAMES FERGUSSON, who was Postmaster-General in the year 1891, a position in which, it is stated, he was responsible for the signing of the agreement with the National Telephone Co., Ltd. At the time of his death he was a director of that company, and was also connected with several commercial undertakings. Sir James was born in 1832, and so was in his seventy-fifth year.

A correspondent writes:—"News has just been received at Barrow-in-Furness of the death of Mr. DAVID MILLARD (late of that town). The deceased gentleman left England only a few months ago. He was for some time engaged in the Corporation Electrical Works at Barrow, and afterwards in the electrical department at Messrs. Vickers, Sons & Maxim's extensive works. He left this country to take a post as electrician in Carnegie's Steel Works, Homestead, where his abilities were recognised by early promotion. The real cause of his death was a mystery, though it is surmised, from the position in which the body was found, that the unfortunate gentleman had been knocked down by an engine when crossing some lines leading from the works. We understand that the affair was purely an accident."

NEW COMPANIES REGISTERED.

London Electric Hot-Air Baths (Greville's System), Ltd. (91,512).—This company was registered on January 3rd, with a capital of £5,000 in £1 shares, to acquire the business carried on by H. E. Greville at 31, Upper Berkeley Street, W., and to carry on the properties of electric, hot-air and other baths, &c. The first subscribers (each with one share) are:—Helen I. Hughes, 31, Upper Berkeley Street, W., matron; W. J. F. Elliott, 30, Deacon Road, Willesden Green, N.W., bath attendant; H. E. Greville, 7, Rutland Park, Willesden Green, N.W., solicitor; Alice O'Donnell, 31, Upper Berkeley Street, trained nurse; T. W. Precious, 51, Halley Road, Forest Gate, clerk; H. J. Garlick, 25, Chesham Buildings, Grosvenor Square, W., clerk; and A. J. Strahle, 64, Lansdowne Road, Holland Park, W., secretary. No initial public issue. Registered without articles of association. The first directors are H. Stedman, J. S. Jarvis and H. E. Greville. Registered office, 2, Staple Inn, Holborn, W.C.

Mercedes Petrol-Electric Co., Ltd. (91,526).—This company was registered on January 4th, with a capital of £1,000 in £1 shares, to carry on the business of manufacturers of and dealers in motor-cars, cycles, carriages, omnibuses, boats, launches, &c., whether propelled by petrol, motor, motor-mixte, electricity or other power, &c. The first subscribers (each with one share) are:—A. Ireland, 58, Blenheim Road, Walthamstow, clerk; J. S. Cropper, 7, Union Court, E.C., company director; L. E. Chafnial, 67, Filmer Road, Munster Park, S.W., merchant; W. T. Gittens, 23, Wentworth Mansions, Hampstead, N.W., secretary; A. H. Greenhill, 19-21, Queen Victoria Street, E.C., secretary; F. H. Byrne, 28, Milton Road, Highgate, N., secretary; and A. Atkinson, "Bathurst," Fallow Court Avenue, North Finchley, merchant. No initial public issue. Registered without articles of association.

Newark Electric Supply Co., Ltd. (91,461).—This company was registered on December 31st, with a capital of £1,000 in £1 shares, to carry on the business of electrical engineers and contractors, electricians, suppliers of electricity, manufacturers of electrical apparatus, generators, producers and suppliers of light, heat, sound and power by electricity, galvanism, magnetism or otherwise, &c. The first subscribers (each with one share) are:—C. E. Warren, Zedecco, Maidenhead, engineer; A. Blackmore, 6, Throgmorton Avenue, E.C., engineer; W. Skinner, 6, Throgmorton Avenue, E.C., F.C.I.S.; J. D. Adams, Tyle Lodge, Addlestone, engineer; A. D. Withers, 12, Keppel Street, W.C., electrician; C. N. Nixon, 14, Heathcote Street, Mecklenburgh Square, W.C., managing clerk; and J. R. Threadgold, 13, Glenhouse Road, Eltham, clerk. No initial public issue; registered without articles of association. Registered office, 74, Coleman Street, E.C.

William Sharpe & Son, Ltd. (91,548).—This company was registered on January 5th, with a capital of £5,000 in £1 shares (2,000 8 per cent. preference), to acquire the business carried on by Sharpe & Son, to adopt an agreement with William Sharpe & Son, and to carry on the business of heating, lighting, ventilating, gas, water, sanitary and constructional engineers, electricians, suppliers of water, gas and electricity for heat, light, motive power or other purposes, manufacturers of electrical and other apparatus, &c. The first subscribers (each with one preference share) are:—W. Brown, Grant Thorold Park, Grimsby, surveyor; J. W. Franklin, 3, Bucklersbury, E.C., land agent; J. Morgan, 3, Bucklersbury, E.C., auctioneer; F. H. McCardie, 7, Austin Friars, E.C., stockbroker; F. G. Barker, 3, Bucklersbury, E.C., land agent and surveyor; D. Mills, Tweed House, Nether Street, Woodside Park, N., engineer; and E. Richards, 6 and 8, Eastcheap, E.C., merchant. Minimum cash subscription, £500 preference shares. The number of directors is not to be less than two or more than seven; the first are F. H. McCardie, W. Brown, F. G. Barker and W. Sharpe; qualification (except first directors), £1: remuneration (except managing directors) one guinea each per meeting. Registered office, 3, Bucklersbury, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ferranti, Ltd. (83,718).—This company's annual return was filed on November 21st, when 53,318 preference, 60,000 ordinary and 10,000 deferred shares had been taken up out of a nominal capital of £130,000 in 60,000 preference, 60,000 ordinary and 10,000 deferred shares of £1 each. £123,318 is considered as paid. Mortgages and charges: £130,000.

Nottingham Gas and Electric Fittings Co., Ltd. (89,587).—A debenture dated December 3rd, 1906, to secure £199 0s. 1d., charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: W. W. Favei, 23, Rood Lane, E.C.

Topsham Electricity Supply Co., Ltd. (80,826).—£200 4 per cent. debentures, created October 22nd, 1906, charged on the company's property, present and future, including uncalled capital, have been registered. No trustees.

CITY NOTES.

British Westinghouse Electric and Manufacturing Co., Ltd.

THE seventh annual general meeting of this company was held at Hamilton House, Victoria Embankment, on Monday last, 14th inst., Mr. J. Annan Bryce, M.P., presiding.

The CHAIRMAN, in moving the adoption of the report, of which we gave full particulars on page 73 of last week's ELECTRICAL REVIEW, said he was sorry that their chairman, Mr. Westinghouse, was unable to be present, owing to the serious illness of his only son. In referring first to the balance-sheet, he said that there having been no provision for depreciation, the profit and loss account was omitted as a separate statement, and the items were included in the general balance-sheet. The full amount of debenture stock had been issued and sold, with the exception of the £221,000 held in respect of land at Trafford Park. On July 31st, temporary loans consisted of £135,000 owed to the American company, and £125,000 to bankers. Since that date, the bankers' loan had been paid down to about £90,000 out of receipts, and the balance arranged for as they would observe in the statement that he was authorised to make in behalf of the American interests; these interests had agreed to purchase their holdings in other companies at par to the amount of about £135,000, to apply against the loan to bankers and in the liquidation of certain accounts under the heading of sundry creditors. In addition to this, the American interests would continue the present loan of £135,000 for two years. Respecting the further requirements of the company, these interests contemplated the purchase of an additional amount of this company's holdings in other companies. From this they would observe that their American allies not only had confidence in the ultimate success of the enterprise, but were willing to back this confidence by continued and liberal financial support. He might say that, notwithstanding the losses to which he would have occasion to allude, the company was in a thoroughly sound financial condition and capable of carrying out satisfactorily in every way all the business which it might undertake. Although there was no provision for depreciation, the property and plant had been carefully maintained in first class condition, and the cost charged to revenue. Owing to the volume of new business, there had been an increase in the item stock and

material on hand and in process of manufacture of about £60,000 over the figures of the preceding year. As regards the heading completed work on contracts, there had been a marked increase in the rate of collections which was satisfactory as showing the improvement in the organisation, to which he would have occasion to refer again. The total of completed work on contracts and sundry debtors last year was £787,237, as against £753,994 for the year under review, and since the close of the last fiscal year, completed work on contracts and sundry debtors had been still further decreased by £200,000 notwithstanding increased shipments. Their holding in other companies consisted principally of shares in the Traction and Power Securities Co. and the Clyde Valley Electrical Power Co. The former company owned a large amount of Mersey Railway debentures, which were steadily improving in value. The Clyde Valley Co. had made good progress during the past year. It had a total installation of upwards of 8,000 KW. and was installing an additional 4,000-KW. unit. The demand for its output was steadily growing, and it now had on its book contracts for several thousand horse-power. With respect to the suspense account, a careful record had been kept of the expenditure on development and experimental work not chargeable to orders in hand. While it was essential to carry on development work, it was their intention to restrict it within the lines of careful economy. With regard to the heading adjustment of working assets, there had been during the year under review numerous adjustments in respect to stock-on-hand and other items which entered into manufacturing accounts, all of which had been included under this heading. He now came to the question which must be in the minds of all of them. What had caused the losses of the past few years and what could be done to prevent similar losses in the future? In the first place, the works were laid out with the expectation of a large electrical development in Great Britain, but up to the present time the scale on which the works had been installed exceeded the demands of the trade. To operate the works a staff in keeping with their magnitude was organised. While it was always difficult to assemble an efficient staff (which ought to be the growth of years) it was necessary to effect the organisation within a limited time, with the result that the *personnel* proved to be unequal to the task of conducting the affairs of the company with profit under conditions of strong competition. A year ago, after a careful investigation, the directors decided that radical changes were necessary in the *personnel* and methods of the company. In view of the many important changes that had been made during the past twelve months, it seemed desirable to tell them something of the present organisation. The directors were fortunate in securing and appointing last June a general manager of works who had had many years' experience in the management of large shops and in the methods of electrical manufacture that resulted in economical administration. The results so far showed a marked increase in production, with a material reduction in the pay-roll. A transfer had been effected to the works at Manchester of the sales management and engineering staff, with the result of a considerable economy in London office expenses. The directors were of the opinion that the company now had an efficient works and sales organisation and was well equipped for carrying on the business. If the business was to prosper, it was essential that a larger volume of orders should be put through, so as to diminish the proportionate burden of the necessarily heavy standing expenses. During the past five months their sales had increased 50 per cent. over the corresponding period of last year. The returns showed a manufacturing profit, and although this profit was small, the result, when compared with the considerable loss during the corresponding period of last year, was encouraging. In view of the slackness of home business, their export department had received special attention, and their directors looked for a still further increase in view of the new territorial arrangements made with the American company. They would recall that under the agreement their company confined its operations to Great Britain and her possessions, excluding Canada. A promising field for British electrical apparatus existed in South America. Several months ago the America company was approached with a view to an agreement whereby the British company might sell its product without restriction in South American countries. This had been arranged, and an increase of business had already resulted. The condition of the home trade was still unsatisfactory. Low prices prevailed, and to meet these every effort was being made towards economy in production. The quality of apparatus manufactured was, however, of first importance, and every care was taken to maintain a high standard. If the efforts which were constantly being made towards standardisation were successful the amount of special apparatus which their works were called upon to construct would be greatly reduced, and the British electrical manufacturer would be able to produce his apparatus under conditions more nearly approaching those existing in America and Germany. But, while the prospects of the business thus appeared more favourable, the directors, after long and anxious consideration, had come to the conclusion that the only way to place the company in a sound position was to reduce the capital. Proposals to this effect would be submitted later, but it appeared desirable at this stage to explain their general bearing. Speaking generally, the result of carrying these proposals into effect would be to clear off the accumulation of losses on contracts undertaken in past years, and to reduce the figures of their assets to a point consonant with their value. As regards the proposals for reduction of capital, he should explain that the interests of the preference shareholders were not injuriously affected. It was proposed that while the nominal value of the share was reduced from £5 to £3, the original value of £5 was preserved in the event of a liquidation, so that in that event the position of the preference shareholder would be relatively precisely the same as at present. Similarly, he would be in precisely the same relative position as regards dividend, it being proposed that the preference dividend when payable should be raised from 6 to 10 per cent. The preference shareholdor would thus receive exactly the same proportion of the amount of the earnings distributable on dividend as that to which he was at present entitled, viz., up to 6s. per share. Since the designing of their works in the late nineties, and since the placing of the orders for the machinery, there had been many important changes in the style of apparatus. For instance, the reciprocating engine of large size which was then in vogue had been very generally supplanted by the steam turbine. The result of these changes had been that a large part of the expenditure on foundations, buildings, cranes and heavy machine tools had proved, for the present, unnecessary. To meet these modified conditions, it was thought necessary to reduce the book value of the plant and property. The company held many patents of great value, but with the writing down of the works it was, of course, also necessary to reduce the book value of patents and goodwill. It was also necessary, in view of change in type and keen competition, to write down the value of stock-on-hand and in process of manufacture. In order to provide for these reductions, and to write off losses and development expenses, it was proposed to reduce the capital by £1,375,000, of which £1,000,000 was in respect of the preference shares, and £375,000 in respect of the ordinary shares, which was a reduction of 40 per cent. on the preference and 50 per cent on the ordinary. He then formally moved the adoption of the report.

Mr. J. K. Lukach seconded the motion.

A very lengthy discussion ensued.

Dr. D. Browne said it had been his misfortune from year to year to criticise the managers and directors for the fruitless manner in which they had worked the company. This year, like a pistol at their heads, this proposition was placed before them, knowing full well that shareholders were in their power. Though they were in a minority, still minorities had their rights, and he was certain that at a meeting like that would exert their rights. Last year he drew attention to the fact that two of the directors, like rats, were forsaking the sinking ship. One of them took exception to what he said, but he said that owing to increased work and so on, he would be unable to continue upon the board. But the rats had forsaken the ship, and they were left to sink or swim. He had followed the speech from the chair with some thought, and he thought it had put forward a poor apology for Mr. Westinghouse. Before this company was started, he came over to this city and caused a flutter by his speeches, telling us how ignorant we were, how unskilful we were in engineering and electrical work, and that he was the apostle to teach us. Contrast those speeches with what had come from the chair that day. If Mr. Westinghouse was a man of courage, he maintained that he would have been there that day and faced the music. They were told each year that there was an excuse—one year it was other business, another it was as they had heard that day. At the seventh annual meeting he and his directors submitted a balance-sheet showing that they had squandered in patents and so-called goodwill £794,567, which, if sold to-day, would not fetch £50,000. They had spent £1,082,000 upon Trafford Park—a place full of obsolete machinery and old iron. Bad and doubtful debts were £135,000; shares in other companies £433,827, with a contingent liability (was that good finance?—for a company like that to sink £400,000 and then have to go to America to borrow money?). It seemed to him most ridiculous. What was the market value of those holdings to-day, and the dividends that were drawn from them? They had a suspense account of £108,253, and some £79 000 added to it, which represented useless experiments. To wind up that tale of woe they, with all their expert skill, showed a stupendous profit of £7,567 on a capital of nearly £5,000,000. He must congratulate them upon their face and courage in coming to the meeting with this tale. A more damning criticism he never read from a firm of auditors than that contained in their auditors' report. This state of things gave them cause for reflection. A body of gentlemen undertook a most important duty of managers of a great company, with almost unlimited funds at their disposal—could they say that they had done their best with the money placed at their disposal? No doubt in the manufacturing world they posed as specialists, but heaven defend him from such specialists. As a shareholder he told them that they had totally failed in their conduct of the company, and he would deal with a few matters affecting the management to enforce his contention. Certain works were carried out at Chelsea, costing the company £15,000. He maintained that much of that money might have been saved by proper supervision of labour and material. There were also some queer stories about engineers having extra work done for themselves and charging the company, also of the employment of incompetent and unskilful men upon important works. He knew of one big contract where the men put to special work had not the slightest experience. The company's reputation, he said, was ruined by extravagance, by mismanagement, and the want of a tight hand. The company had been robbed right and left—he maintained that without contradiction. The speaker moved an amendment:—

"That we refuse to carry out their scheme, and that a committee of shareholders be appointed to go into matters fully, and, further, that we pass a vote of want of confidence in our management."

They had lost in works and contracts large sums—that they acknowledged, the patents and goodwill were valueless—and after that they invited the shareholders to prolong their term of office and trust them further to borrow more capital and continue the game. In a year or so more they would be met with another proposal, and they would be simply squeezed out—there was no hope for them. It had taken seven years for the board to find that they had lost their money, their credit and their good name.

A Shareholder at the back of the hall created somewhat of a diversion by asking again and again what was a preference share. It transpired that he had been to Bow Street Police Station that morning to know what he could do against the company criminally. The chairman later gave a definition of what a preference share should be, but the said shareholder, who had brought his solicitor with him, went away sorrowful, for he had *not* great possessions.

Captain Bedingfield, in approving of what Dr. Browne had said, drew attention to the suspense account, which he spoke about last year. He then said it was practically giving the company away, and would take many years to reduce it. Instead of any att mpt being made to reduce it, it had been increased by nearly £80,000! For what?—that was the point. Then again there was the item shares and debentures in other companies, £433,000. Supposing the company went into liquidation now, it was very doubtful whether that amount was good or not. He should also like to ask what did an adjustment of working assets mean? The balance-sheet wanted some explicit explanation. Would Trafford Park works fetch £1,080,000 in the event of liquidation? They were asked to write off a certain amount of money "practically chucked into the gutter," and start *de novo*, having wiped off that suspense account and the other million. It was all absolutely dead loss. There was evidently want of supervision in small matters. The proxy stamps were a case in point. A millionaire could afford to lose, but a poor man missed half-a-crown.

Mr. Dingwall asked under what article it was proposed to increase the board's borrowing powers. He could not see anything about the matter under the special resolutions. It was only due to extravagant borrowing in the past that the company had been brought to its present position. The proposal to raise the rate of dividend from nothing to 10 per cent. or 12 per cent. seemed difficult to conceive of. Theodore Hood gave an I.O.U. for £5, and said "Thank Heaven that's settled!" Another company in a very similar line had managed to pay very decent dividends to its shareholders. Bad state of trade was hardly shown by that fact. What was the advantage of that further £79,000 spent experimentally? There did not seem to have been any advantage gained from money so spent in the past. That the capital must be cut down seemed inevitable, but he thought there might be a committee of investigation appointed, and that they should accept the resignation of the gentleman who retired at that meeting, and get another.

Mr. Herbert Smith said that a statement such as the board had made was calculated to provoke criticism. This was, however, essentially a business meeting, and their one and only object should be to conserve their business interests. It was more than highly probable that the causes which had led up to the proposals of to-day were causes which went far back in the company's history, and if the management and executive of the company had been maintained in its integrity from the beginning until now, it might possibly be that there would be room for much more microscopic examination or full criticism. They knew that recently the executive power of the company had been placed in new hands, and as far as he had been able to make inquiry, those hands were very able and capable. He did not know a single director of the company, therefore personal sympathy did not sway him when he said that he thought it was in common fairness to newly arrived management to give it a chance of justifying itself. It was for them to recognise that microscopic examination of causes was, at best, of academic rather than of practical interest, and he would not object to that microscopic examination if he thought that matters ended there, but he ventured to think it might be positively harmful to their interests, because they all knew that every individual had his weak point. He had never yet found any good to result from an individual advertising what his weak points were. Achilles was unarmoured at the heel, and was eventually killed. It was wise for them to consider and inquire into the position of to-day, for it was upon that position that the directors had founded the proposals now made. Before the scheme for reduction of capital could be carried into effect they had to obtain an order of the Court, and that could not be obtained except upon a full *exposé* of the company's position and full justification of the step it was proposed to take. The Court was rather hard to satisfy in that matter, so that while he recognised that they were justified in satisfying themselves as to the facts of to-day, that inquiry would be made at least as effectively before the Court. They did not necessarily advance their material interests by making an envenomed attack when the board was not as it was when the company started its operations.

A Shareholder spoke of a visit to the works, and the excellent state of things as he found them.

Sir Henry Bergne asked what was the amount paid for goodwill apart from patents; to whom was it paid; and if the scheme were carried through, how much of that sum was it proposed to write off?

Mr. Jeffcote asked how many debentures the American Westinghouse Co. held in the company altogether. If the company went on as it was doing, the time would not be very long before the debenture-holders would take possession of the company and they would all be pushed out. In regard to the readjustment of trading territory which had been the subject of negotiation with the American company, and under which this company was supposed to gain something, what had this company given up to the American company in order that they might have this right of trading in South America—any rights in England?

Mr. Stevens said that the directors had spoken of an increase of business and a decrease of working expenses. Could they give the percentage of increase of business and of cost for the last three years, so as to give some idea how the thing was grading both ways?

After a few words from another shareholder,

Sir Joseph Lawrence said that from no one except Mr. Herbert Smith had be heard anything in the nature of a moderate or constructive proposal. When Mr. Westinghouse came over here and invited Englishmen to put money into this enterprise, he held out what he conceived to be the well-grounded hope that there was to be a great advance in the electrical business in this country. He said that American railways were making arrangements for electrification, and that in this country it was only a question of five years before most of our trunk railways would attempt to change from steam to electricity. He said his colleagues were willing to embark, to throw in the whole of their patents and goodwill and business knowledge and experience in Europe. A great number of them put in their money, and assisted him most cordially. They believed in him implicitly, not only because he was a man who had established a great reputation in America for ability, but because of his special knowledge in this electrical trade. He was backed by men of the highest reputation, and he was taken up in this country by men of the highest standing in the financial world. They had on the board at that time some very practical men, among them the Hon. R. Clay Parsons. It was one of the greatest sources of regret that he ever left the board of the company, and if there was a finger of complaint that could be raised against the organisation, it was that they had not strengthened the board by putting on practical men, and they had not the active personal superintendence of Mr. Westinghouse himself. For a great industry like this to be conducted and inspired from a distance of 3,000 or 4,000 miles was impossible. A responsible head of such an undertaking must reside in this country. He was making no complaints against Mr. Westinghouse, he knew his difficulties, and had known them all along. Here was a man who believed in the enterprise, and had backed it up with his own money. Out of 2½ millions of preference shares, he should say he owned up to 1½ millions. He took ordinary shares, half of which he proposed to wipe off, and he was also putting up money in debentures. What could they say of a man who backed up his opinion with his money? They could not say the same of him as they could of directors who were mere dummies and guinea-pigs. What was the real inwardness of the loss of trade to this company? They could not to-day in an electrical manufacturing industry in this country compete with Germany on an even keel. A Manchester Corporation contract for £120,000 which went to the A.E.G., and a £70,000 contract for another company which went to Sigismund Bergmann, at £36,000 and £18,000 respectively below the Westinghouse prices, were quoted by the speaker to support this view. In Manchester the staff found itself unable to compete efficiently and economically with the strong competition on the Continent. They got men, and tried to cut down the foremen and managers, and they left and went to other works, and got bigger salaries. They missed the contracts on the one hand, and they tried to economise, and somebody got the benefit of their knowledge. These were causes lying much deeper. If they got their chairman (Mr. Bryce), and men like him, to say let us keep our home market for ourselves they would be able to do trade. The Germans had the whole control of their own market, and their Kartel arrangements enabled them to replace losses on contracts secured outside Germany. There was the position, and they could not, under the present conditions, look for very much improvement. They must cut down the capital, keep working expenses down, and direct their attention to every nook and corner of the undertaking; but he failed to see what they could do with a committee, because the board had proxies and could vote such a proposition down. He thought they would have to grin and abide for a time, and give the directors time to work out fairly the policy they were working on. He hoped the amendment would be rejected.

Mr. Flint said if it was impossible to earn profits owing to German competition, how was it that other large companies were able to earn them? They also had to compete with the Germans. They were very large companies, and earned very large profits and gave dividends to their shareholders. Why were the Germans more antagonistic to this company than to others in the tenders they sent in? Where was Mr. Westinghouse, and where was Mr. Buchanan? Two years ago Mr. Buchanan spoke at their meeting, and he seemed to be thoroughly acquainted with business matters, and it looked as though he would put them upon a more thoroughly satisfactory basis than before. Shareholders would have liked to hear from Mr. Westinghouse personally what his impression of the past was, and, more important, of the future. In order to enable them to meet Mr. Westinghouse, the meeting should be adjourned to such time as he could attend and meet them and give them his opinions and answer questions. He would move that as an amendment.

This was seconded by Mr. Curtis.

Another Shareholder suggested that part of the works and offices should be let, saving a few thousands.

The Chairman, in reply, said he had the greatest possible sympathy with the dissatisfaction expressed by the various shareholders in regard to the position of the company. Mr. Westinghouse and the other directors felt it as deeply, and more deeply in many ways, in proportion as they were more largely interested, than any shareholder possibly could, and they took to themselves the due blame for the past, to a great extent, mismanagement of the company. He agreed with Mr. Smith that they should look to the future rather than to the past. In regard to the suspense account, the additional expenditure had been caused by the necessity of doing development work which could not show profits for a long time to come; it might never show a profit, but they hoped that the work, which was represented by that figure would, in the course of future years, show profit; still it was one of the things it was absolutely necessary to get rid of from the accounts. Mr. Dingwall had referred to the increase of borrowing powers; as the capital

was to be reduced, the borrowing powers were to be altered. It was no good for the board to exist unless it had power to borrow. They could not conduct the affairs of a company like this without borrowing. No more money was borrowed than was absolutely necessary. The directors fees were £2,000. Sir H. Bergne asked about the patents; the amount paid was £794,000, that was £40,000 in addition to the first sum paid by the company, but that first sum was paid to the Westinghouse Company for its goodwill and patents in ordinary shares (no cash whatever was given) which it was now proposed to write down by one-half. The total holding of the American company was not quite so large as Sir J. Lawrence had said. The total amount of preference shares was £2,500,000, and the American company held £1,200,000. They held the bulk of the ordinary shares, and debentures amounting to £675,000. They practically held one-half of the whole cash capital of the company. In reply to Mr. Stevens regarding the increase in business, there was no increase in the two years preceding the present fiscal year, but since the end of the last fiscal year the amount of business had increased by 50 per cent. Their business was largest in 1903, it fell off in 1904, and 1905 was about the same; in 1906 it was considerably smaller, and now there was an increase of 50 per cent. over 1906 in the first five months of the current year. In regard to the new reciprocal trading arrangement, it was reciprocal to this extent. The American company had given this company the right, which they had not previously, to sell in South America, and this company had given them the right to sell in any British possession except England. Notwithstanding what Sir J. Lawence had said, he thought it would be found that the English maker could manufacture electrical apparatus more cheaply than the American company, and therefore while they had given them under this arrangement the right to sell in other British possessions than England, Mr. Westinghouse recognised that he was not likely to sell much in them. In England they could manufacture cheaper, and so while they were getting an entry into South America, the American company would not be likely to do much business in British possessions.

Sir JOSEPH LAWRENCE pointed out that he said nothing about manufacturing in America.

The CHAIRMAN, proceeding, said that there was a very strong movement against the continuance of those Kartels and Trusts under which the competition was allowed to exist. He believed it was for evil interests that those combinations should exist. He was sure those countries would bring an end to them within a measurable time—then this company would be in a better position to compete, and there was no need for what he regarded as fallacious remedies. The American company would be able to sell in consultation with this company. He believed this company would gain by the arrangement.

A SHAREHOLDER said he did not think it likely that the Americans had given them anything worth having for what they had given them. He strongly deprecated the appointment of a committee.

On the amendment for the appointment of a committee being put to the meeting, it was lost, only two voting for it.

The adoption of the report was then agreed to with a few dissentients.

Mr. Lukach was re-elected a director, and the auditors were also re-elected.

The meeting then considered the special resolutions, and these were passed as follows:—

1. That the capital of the company be reduced from £3,250,000 (divided into 500,000 preference shares of £5 each and 75,000 ordinary shares of £10 each, all fully paid) to £1,875,000 (divided into 500,000 preference shares of £3 each and 75,000 ordinary shares of £5 each), and that such reduction be effected by cancelling paid-up capital which has been lost or is unrepresented by available assets, to the extent of £2 per share on each of the preference shares and to the extent of £5 per share on each of the ordinary shares, and by reducing each preference share to a share of £3 and each ordinary share to a share of £5.

2. That Article 9 of the company's articles of association be altered by adding thereto a proviso that, in the event of the resolution for the reduction of the company's capital passed on January 14th, 1907, becoming effective, then the expressions "money paid or credited as paid" and "amounts paid or credited as paid" wherever appearing in the said article, shall, when referring to reduced preference shares, be deemed, notwithstanding such reduction, to be the sum of £5 per share, and when referring to reduced ordinary shares shall be deemed, notwithstanding such reduction, to be the sum of £10 per share.

3. That Article 10 of the company's articles of association be altered by adding thereto a proviso that in the event of the resolution for reduction of the company's capital passed on January 14th, 1907, becoming effective, then the figure 10 shall be substituted for the figure 6, the word "like" in the tenth line of the said article shall be deemed cancelled, and after the word "dividend" next occurring after the said word "like" the words "at the rate of 12 per cent." shall be inserted.

4. That Article 85 of the company's articles of association be altered by adding thereto a proviso that in the event of the resolution for the reduction of the company's capital passed on January 14th, 1907, becoming effective, then the words "10 per cent. on the preference shares and 12 per cent. on the ordinary shares" shall be substituted for the words "6 per cent. on both classes of shares.

5. That Article 14 of the company's articles of association be altered by omitting therefrom all the words after the word "determine" in the tenth line thereof.

The chief discussion centred round No. 5, strong objection being taken to it because of the unlimited borrowing powers which it conferred upon the board. On a show of hands, by a very narrow majority, the proposition was rejected, but further discussion ensued giving fuller explanation, and the vote was taken again, with the result that there was still a majority against. A poll was demanded, but it was shown that the passing of the resolutions was inevitable, so that the poll would only have wasted time, on account of the big holding of proxies held by the board. This position was with reluctance accepted by the opposition, and they ultimately allowed the resolutions to pass. Suggestions were offered from the meeting that a limiting figure for borrowing should be embodied, but this the board would not accept.

Meetings of preference and ordinary shareholders followed, at which the resolutions were agreed to.

Kent Electric Power Co., Ltd.

THE directors, in their report for the year ending December 31st, 1905, submitted to a meeting of shareholders held on 15th inst. at Salter's Hall Court, Cannon Street, E.C., take the opportunity of reviewing the present position of the company. The net revenue account for the year shows a loss of £78. The accounts for the year just closed are only completed for the 11 months ending November 30th, 1906, but it is evident from them that in consequence of the heavy price which the company have had to pay to the Gillingham Corporation for energy in bulk, *i.e.*, about £6,000 on a gross revenue of about £7,000, and the general disorganisation caused by the fire (which destroyed the Whittaker Street generating station in June, 1905), that the loss for the twelve months ending December 31st, 1906, will be considerably increased; but the directors anticipate that now that the new power station at Frindsbury is at work this condition of affairs will be entirely changed. The accounts for the year closing December 31st, 1906, are so far advanced that the directors hope to issue them to the shareholders early in the present year. The efforts of the board have been directed, during the year which has elapsed since the circulation of the debenture stock prospectus, to the business of electric lighting in Chatham, Rochester and district on the one hand, and on the other hand to the erection of the first portion of the generating station at Frindsbury by the Kent Electric Power Syndicate, Ltd., under the terms of the contract, particulars of which have already been placed before the shareholders. Certain modifications have been made in the terms of the contract in this company's interests, and these will be submitted for confirmation. Under the first heading the board are able to report an increase of business, notwithstanding the disorganisation consequent upon the fire and the great difficulties arising from the temporary supply. It was considered desirable to take advantage of the break in the supply caused by the fire, to reduce the price of current by nearly 25 per cent., a policy the directors have found justified, as not only has the business been kept together, and the goodwill maintained, but the sale of energy has increased during the re-organisation period. Practically the whole of the loss due to the fire was covered by insurance. Under the second heading the directors announce that the first portion of the generating station at Frindsbury is now completed to the point when it has been found possible to dispense with the supply of energy from Gillingham, and to take over the load, and they trust from this point onwards they will be able to report continuous progress. At the date of the issue of the debenture stock prospectus last year, the engineers anticipated that a period of about eight months from that time would suffice for the erection of the plant. Unexpected delays, however, took place in the delivery of some of the most important parts of the machinery. Moreover, some important modifications have been made in the general scheme of arrangements, which it is anticipated will make for greater efficiency. The directors hope, without waiting for the general meeting in March, to invite the shareholders and debenture stock holders of the company to meet them at the works early in the present year, when they will have an opportunity of inspecting the station and considering the accounts for the year 1906 as above indicated. The directors report good progress in relation to their negotiations for supply of energy. Some important contracts have been signed, and others are in a forward state of negotiation. The engineers of the company have made a report to the board upon the present position, from which it appears that by the close of the year 1907 there should be a gross revenue at the rate of £18,000 per annum, and further, that an expenditure of a further £8,000 for mains beyond the work already in hand will be required. This the Kent Electric Power Syndicate, Ltd., will be called upon, under the terms of the contract, to carry out in due course.

It has become necessary for the board within the past year to turn their attention very seriously to affording a supply under the Electric Lighting Provisional Orders held by the syndicate, but controlled by the company. Accordingly mains have been laid with a view to the commencement of supply in the Strood rural area. An agreement was entered into with the Bromley (Kent) Electric Light and Power Co., Ltd., for the commencent of supply in the Bromley rural district upon terms which will yield some small profit to the company pending this work being taken in hand on a larger scale by the company, and negotiations are in progress with the South Metropolitan Co. for a supply upon similar terms in the Mottingham area. The Kent Electric Power Syndicate, Ltd., has at the request of the company arranged under a modification of the terms of the contract of February 7th, 1905, to carry out the electric lighting installation at Sevenoaks at a cost which is estimated at between £10,000 and £12,000.

The shareholders are, no doubt, aware of the encroachments which have been sought to be made within the areas immediately adjacent to London in the past two sessions of Parliament, and that the area of the Kent Electric Power Co. was no exception. The company was in consequence compelled to oppose these attempts in Parliament, and so far the area is intact; but in the coming session the London County Council are by their Bill again attempting to obtain competing powers in parts of your area, but the directors trust they will again succeed in maintaining the company's area intact.

In the last session of Parliament your board considered it essential that the company should apply to Parliament for extension of powers in various respects. This Bill was duly passed, and your Supplemental Act is likely to prove of the utmost value to the company. Not only have important facilities been granted to the company by Parliament for the internal management of the company, including facilities not hitherto granted in relation to capital and borrowing powers, but your powers have been brought into closer analogy to those of a limited liability company. Furthermore, the important right has been obtained of issuing shares or debenture warrants to bearer, powers to which the company's financial advisers attach the highest importance. Clauses have also been sanctioned which empower the company, with the approval of the shareholders as therein provided, to allocate the profits of any particular part of the company's undertaking to the payment of interest on a particular class of shares.

Mr. G. H. BROUGHAM GLASIER presided on Tuesday at the meeting. He said that one of the most important things that had occurred was that the new station at Frindsbury had been taken over from the first of the month, and was doing all the work that was necessary. The first portion of the Frindsbury station was now complete, and he hoped the shareholders would take the oppor-

tunity of going down to the station very shortly, and seeing it for themselves, as no explanation could do justice to what their engineers could show them. Good progress had been made in regard to the negotiations for the supply of energy, but this was best seen from the engineer's report, which he would ask Mr. Addenbrooke to read.

Mr. G. L. ADDENBROOKE read the following report, dated January 1st, 1907:—

In the interval which has elapsed since the date of our report accompanying your prospectus, the first portion of the Frindsbury station has been erected on the lines there indicated, with some additions, and is now in operation. The additions chiefly consist in the installation of a 500-KW. turbine generator; this was in the fire at the company's old station, but the makers afterwards found it to be little damaged, and it has since been reconstructed and re-erected in the new station, which was correspondingly extended to receive it. The two new 1,500-KW. turbines have also come up fully to specification on their trials, and, we expect, will be found capable in practice, of carrying a larger load than was estimated for in our report. By the provision of further boiler power, the capacity of the company's new station will therefore be larger and will have a greater earning power than we previously assumed. Upon the question of the company's position and prospects, we have conferred with your manager. Taking the revenue from the lighting undertaking at a conservative figure, and the revenue from the contracts already signed, these are equivalent, in our opinion, to an assured revenue at the rate of £11,000 per annum. In addition, however, to contracts actually signed, there are a large number of negotiations in an advanced stage, but which consumers would not complete pending the opening of the company's station. Assuming that only one-fourth of these negotiations are shortly completed—and your manager considers he can complete them nearly all within the year—there will be a revenue of something over £13,000 per annum, the sum which on a careful estimate will be needed to cover the company's operating and general expenditure, and interest on the debenture stock. The conclusion of the greater proportion of the above negotiations, or of others of equivalent value, which are also in prospect, should, we think, by the end of the year 1907, bring the company's gross revenue to the rate of about £18,000 per annum, which, after deducting outgoings and debenture stock interest, would leave about £3,000 available for depreciation and dividend. To obtain this revenue it will be necessary in due course to call upon the Kent Electric Power Syndicate, Ltd., to execute additional work on the distributing system, under the terms of the contract with them to the extent of about £8,000. The total earning capacity of the present station, with some additional boiler power, is in the neighbourhood of £24,000 per annum. To get contracts with customers taken up to this amount, it will be desirable to further extend the mains, particularly up the Medway Valley. When this is done to the extent we have in view and when the third turbo-generating set is installed in the station and the work you have arranged for at Sevenoaks is complete, the expenditure will be somewhat in excess of the total contract with the Kent Electric Power Syndicate. On the other hand, when the output then available is taken up, the gross revenue should be about £40,000, and the net revenue which could be appropriated for meeting interest, dividends and depreciation should be about £20,000 per annum.

The CHAIRMAN, continuing, said that reference was made in the report to what was a most disastrous thing for electrical companies generally, and that was the fact that everybody seemed to think (and he hoped there was some truth in it) that power companies were a thing which ought to be gone into, because there was such a lot of money to be made out of them. It was common knowledge that the London County Council were this session again proposing to acquire all sorts of powers in areas and districts that were, properly speaking, the property of other companies, and their company, in common with others, was not left alone. This meant a considerable expenditure of money to maintain their rights, which they considered they were entitled to do, and which, in the interests of the shareholders, they were bound to do. It might be that some of them entertained the opinion that before they reached the Committee stage, a very drastic alteration would have taken place in connection with the controlling forces of one of the central departments in London, and that might have the effect of withdrawing all the "kites"—or whatever they liked to call them—wild-cat schemes, which were promulgated by municipal or other authorities, and all of which were proposed to be done at the expense of the ratepayers. He did not think that many of them who had money to lose, liked that kind of thing being done.

Mr. BRADY, solicitor, explained the Bill which the company had succeeded in getting through Parliament.

The report was then adopted.

The retiring directors, Messrs. White and Albright, having been re-elected,

The CHAIRMAN said that under their arrangement with Messrs. Henley, as regarded the equipment of their station, they were required to place a seat on the board at the disposal of that company, to be filled by their nominee, and he moved that the board be authorised to adopt such nominee.

This was seconded by Capt. SWINTON and carried.

The SOLICITOR said a point arose with regard to the remuneration of the directors. In the minutes which had been read, there was a resolution that the remuneration of the directors should be fixed at £10 for each board and committee meeting, to be paid in deferred shares. The resolution went on to say that from the date of that meeting the remuneration for the board should be fixed at £1,750. As a matter of fact, £1,250 of that had been satisfied with deferred shares, and £500 was to be in cash, but the board had not drawn anything like that sum. In view of the modification of the agreement with the Kent Electric Power Syndicate in February, it was necessary that some arrangement should be made, and he accordingly proposed that the remuneration be continued at £1,750, and that it be left to the board, in agreement with the Electric Syndicate, to decide as to how it should be paid.

Mr. WILDE seconded the motion, which was carried.

The meeting was then made special for considering and, if thought fit, approving of the new agreement proposed to be entered into with the Kent Electric Power Syndicate, Ltd., for the modification of the terms of the agreement dated February 7th, 1905. He explained that the first agreement provided for the execution by the syndicate on behalf of the company of certain works, including the Frindsbury station. At that time it was thought that the power company would be able to issue its capital, but that had been impossible, and the finance was provided privately, and the scope of the work was increased from time to time. Therefore it was necessary to alter the agreement. He proposed the resolution.

The CHAIRMAN said that it was most important to start with the Sevenoaks order, but with the Bank rate at 6 per cent., it was impossible to issue capital. Had they not commenced almost immedia ely with that order, they would probably have lost it.

Mr. ALBRIGHT seconded the motion, and it was carried.

The CHAIRMAN said that the accounts dealt with referred to 1905, and, although he was not going to give them a revenue account, they would probably like to have some information as to 1906. During last year they were in the unfortunate position, consequent upon the fire which occurred at their station, of having to enter into an agreement for the supply of energy with a neighbouring corporation, and the price that that corporation charged was such that it left no possible chance of making a profit during the year. They had, however, erected a new station, and matters would be entirely different this year. The number of units generated last year was 573,089, as against 517,795 for the previous year, which was an increase of 10·7 per cent. At the same time, the cost of distribution and management per unit had decreased. It was also satisfactory to note that, although the price charged per unit had been reduced 10·4 per cent., the actual revenue had only decreased 3·3 per cent. The total connections had increased 6·65 per cent., and the net increase connected during the year was 57 KW., which was nearly 13 per cent. better than the previous year. They had made a statement out as regarded what they might reasonably assume would be the results for the current year. They had got their lighting account of £7,750, and they anticipated a further revenue of £3,816. Contracts for nearly that amount had already been signed. Three other good-sized contracts for £2,725 were all but signed, and they had hopes of shortly getting signed other contracts for a further £2,490, which would bring their figures up to nearly the same as the engineer in his report alluded to, inasmuch as the figures came up to a total of just on £17,000.

Stock Exchange Notices.—Application has been made to the Committee to allow the following securities to be quoted in the Official List:—

Commercial Cable Co.—Further issue of £202,779 sterling 500-year 4 per cent. debenture stock (redeemable).

United River Plate Telephone Co., Ltd.—Further issue of 20,000 ordinary shares of £5 each, fully paid, Nos. 80,001 to 100,000.

Dublin United Tramways Co., Ltd.—The directors recommend a dividend for the half-year ended December 31st, 1906, at the rate of 6 per cent. per annum, free of income-tax, on the ordinary shares, after setting aside £5,000 to reserve fund, £1,000 to accident insurance fund, and £4,000 towards maintenance in the current half-year, and carrying forward £6,664. The dividend is at the same rate as for the corresponding half of 1905.

Edmundson's Electricity Corporation, Ltd.—It has been announced that in view of the continued decrease in contract work, the directors have decided not to declare an interim dividend on the ordinary shares for the half-year ended September 30th last, as they consider it advisable to await the results of the working of the whole year, ending March 31st next, before dealing with the matter. At this time last year, an interim dividend was declared at the rate of 5 per cent. per annum on these shares.

Elmore's German and Austro-Hungarian Metal Co., Ltd.—At a meeting of the first debenture stockholders, held in London last week, resolutions were passed authorising the trustees and the company to permit the Metal Co. to raise from their bankers in Cologne, or otherwise, a sum not exceeding £50,000 by way of first mortgage on the Schladern property, in priority to the existing mortgages; and, providing that the date for repayment of the amount represented by the debenture stock of the company should be postponed from July 1st, 1907, to July 1st, 1912, the company to be entitled to redeem the stock at an earlier date at the price of £102 10s. for every £100 of stock. The chairman (Mr. J. McFarlan) said that the resolutions would in no way prejudice the security.

Metropolitan Railway Co.—The directors recommend a dividend on the ordinary stock for the past half-year at the rate of 10s. per cent. per annum, carrying forward about £6,000. On the Surplus Lands stock the dividend is to be at the rate of 2¾ per cent., carrying forward £200.

City and South London Railway Co.—For the half-year ended December 31st, after providing for debenture interest and preference dividends, and the transfer to the renewal fund of £1,500, there is a balance sufficient to allow a dividend on the consolidated ordinary stock at the rate of 2 per cent. per annum (against 1¾ per cent. last year), carrying forward £2,521.

The Western Union Telegraph Co., Ltd.—According to the published statement for the quarter ended September 30th last, the company had in hand on July 1st last $16,848,728 (£3,369,745), and adding thereto the net revenue for the September quarter, viz., $1,660,518 (£552,103), it had in hand $18,509,247 (£3,701,849). After paying the dividend of 1¼ per cent. and interest on the bonded debt, a surplus was left of $16,959,535 (£3,391,907). Net revenue for the December quarter is estimated at $1,600,000 (£320,000), and after allowing for various interest and dividend charges, the total net balance in hand will be $17,009,824 (£3,401,965).

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	*
Aberdeen	Jan. 9	3,739	— 208	31	47,078	+ 1,760	14·4	..
Ayr	,, 12	368	— 20	35	11,911	+ 91	8	..
Bath	,, 12	1,282	— 21	2	1,282	— 21	13	..
Belfast	,, 11	6,267	+ 408	2	6,267	+ 408	40	+ 6½
Birkenhead	,, 13	2,054	+ 9	41	43,697	+ 997	18·62	..
Blackburn	,, 9	1,849	+ 84	41½	43,158	+ 2,674	13·6	..
Blackpool Corp.	,, 10	683	+ 16	39	49,600	+ 3,629	11·87	..
.. —Fleetw'd	,, 12	385	+ 33	52	24,041‖	+ 3,783	8·25	..
Bolton	,, 13	4,523	+ 39	41	87,872	+ 6,980	26	+ 1
Bournemouth	,, 9	2,646	— 95	40½	6-,650	+10,318	21·5	+ 2½
Bradford	,, 5	8,600	+ 165	40	182,688	+ 7,109	53	+ ·7
Brighton	,, 13	1,493	— 100	41	41,034	..	9·5	..
Bristol	,, 11	9,384	— 20	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	,, 4	469	— 23	52	11,651‖	+ 813	3·65	..
Barnsley	,, 4	312	— 30	,,	18,499‖	+ 41	..	..
Barrow	,, 4	468	+ 5	,,	13,436‖	+ 956	5·87	..
Cavehill	,, 4	112	+ 2	,,	4,485‖	+ 1,975	..	..
Devonport	,, 4	885	— 36	,,	23,983‖	+ 132	8·85	..
Gateshead	,, 4	2,016	— 129	,,	51,131‖	+ 2,549	11·25	..
Gravesend	,, 4	403	— 56	,,	12,61‖	+ 584	6·5	..
Greenock	,, 4	1,174	— 115	,,	34,252‖	+ 677	7·25	..
Hartlepool	,, 4	483	— 100	,,	15,517‖	+ 1,560	6·72	..
Kidderminster	,, 4	206	— 26	,,	6,178‖	— 71	..	..
Leamington	,, 4	272	— 27	,,	8,922‖	+ 2,699	3	..
Merthyr	,, 4	464	+ 19	,,	10,467‖	+ 599	2·9	..
‡Metropolitan	,, 4	7,177	+ 890	,,	17‡,41‖	+89,3·5	22	..
Middleton	,, 4	497	— 145	,,	18,066‖	+ 531	8·5	..
Mid. Joint Com'tee	,, 4	15,587	—4,946	,,	520,224‖	+ 7,418	..	..
Oldham — Ashton	,, 4	1,107	— 43	,,	29,967‖	+ 729	9·18	..
Peterborough	,, 4	221	— 40	,,	6,703‖	— 562	5·81	..
Potteries	,, 4	3,720	— 61	,,	94,818‖	+ 4,574	29	..
Rothesay	,, 4	126	— 22	,,	11,040‖	+ 1,6.0	2·75	..
Southport	,, 4	362	— 116	,,	16,378‖	+ 499	8·17	..
S. Metropolitan	,, 4	1,067	..	47	17,773	..	..	..
Swansea	,, 4	1,740	— 18	52	44,268‖	+ 6,116	5·5	..
Tynemouth	,, 4	310	— 75	,,	19,011‖	— 154	3·75	..
Weston-s-Mare	,, 2	52	— 10	,,	7,508‖	+ 634	3	..
‡Worcester	,, 4	503	— 55	,,	14,752‖	— 817	5·75	..
Wrexham	,, 4	215	— 10	,,	5,454‖	+ 170	..	..
Yorks. Wool. Dist.	,, 4	1,869	— 92	,,	47.527‖	+11,668	17	..
Miscellaneous	,, 4	427	— 27	,,	5,962‖	— 284	..	..
Burnley	,, 12	2,389	+ 89	51	..	..	7·5	..
Burton-on-Trent	,, 13	536	— 23	41	12,310	— 455	10	+ 1½
Bury	,, 6	1,780	..	40	39,402	..	10·5	..
†Cardiff	,, 5	2,001	+ 75	40	83,922	+ 1,461	15·87	..
Carlisle	,, 12	319	— 17	2	320	— 17	..	..
†Chatham and Dist.	,, 10	1,281	— 9	52	36,053‖	+ 1,882	12·8	+ 3·5
Cork	..	..	..	52	25,032‖	— 67	9·89	..
Croydon	,, 11	2,457	+ 69	32	47,137	+ 4,139	12	+ ·75
Darlington	,, 12	381	— 1	41	8,706	+ 296	4·67	..
Darwen	,, 11	484	+ 3	41	11,528	+ 497	4·36	..
Dover	,, 5	362	— 30	40	10,372	+ 1,171	4·75	..
Dublin	,, 11	9,411	— 61	52	138,618‖	+ 5,785	18·75	+ ·25
Dundee	,, 9	2,380	+ 41	32	88,065	..	13	+ ·5
East Ham	,, 12	1,689	+ 41	41	37,200	+ 3,107	8	+ ¼
Exeter	,, 11	516	+ 35	41	12,275	+ 450	4·75	+ ·5
Glasgow	,, 12	35,082	+1,954	34	548,675	+46,629	86·75	+11
†Hastings	,, 4	544	..	..	..	..	..	..
Huddersfield	,, 12	2,840	+ 172	41	62,605	+ 5,561	28	..
Hull	,, 12	4,696	+ 129	41	95,927	+ 3,966	13	..
†Ilford	,, 12	423	+ 16	41	19,807	+ 895	6·37	..
Ilkeston	,, 10	224	+ 17	41	5,484	+ 613	3·5	..
Ipswich	,, 12	644	— 36	41	17,748	— 57	10·5	..
Isle of Thanet	,, 12	453	— 11	2	453	— 11	11	..
Kilmarnock	,, 12	320	— 5	35	5,639	+ 81	4·25	..
†Kirkcaldy	Dec. 19	283	+ 33	..	..	..	7·5	..
Lan'kshire Trm. Co.	Jan. 10	1,523	— 183	2	1,523	+ 183	12·56	+ ½
Lancashire United	..	..	..	52	52,432	+ 7,138	37	+ 9
Leeds	,, 5	12,178	+ 618	38	252,678	+15,582	96	+ 6·5
Leicester	,, 12	4,178	+ 51	..	..	..	..	..
Leith	,, 5	1,082	— 7	24	17,670	+ 5,792	6	+ 1
†Liverpool	,, 5	10,804	+ 355	..	..	..	104	+ 1
‡L.C.C.	,, 5	49,013	+21,207	39	1,048,740	+458,504	115	+64
London United	,, 11	10,128	+ 914	52	320,750‖	+28,127	..	..
†Lowestoft	,, 12	294	+ 7	15	2,485	+ 251	3·5	..
†Manchester	,, 12	13,175	+ 765	41	568,683	+40,750	146	+21
Newcastle	,, 12	7,749	+ 307	41	167,180	+11,253	25·5	..
†Newport	,, 5	570	+ 7	40	25,567	+ 1,835	14·5	+ 1·5
Northampton	,, 11	736	— 41	41	18,143	+ 481	5·5	..
Oldham	,, 13	3,362	+ 161	42	75,718	+ 6,789	28·75	..
Pontypridd	,, 12	308	+ 25	41	6,892	+ 896	9·5	..
Portsmouth	,, 12	3,161	+ 43	41	82,673	+ 895	14·5	..
Preston	,, 9	1,316	+ 197	..	..	..	10	..
Reading	Dec. 27	1,267	— 10	39	25,097	+ 486	7·5	..
Rochdale	Jan. 12	1,780	+ 30	..	..	..	20·6	..
Rotherham	,, 10	964	+ 117	41	20,784	+ 1,979	10	+ ·34
Salford	,, 7	7,676	— 837	40	181,347	+ 5,894	33·9	..
Sheffield	,, 13	10,606	+ 868	42	223 945	+15,994	35·75	+ 1½
Southampton	,, 7	1,683	— 122	40	39,849	+ 370	..	..
Southend-on-Sea	,, 9	469	+ 6	41	16,706	+ 1,017	6	..
Sunderland	,, 13	2,623	+ 75	41	58,0.8	+ 3,189	10·87	..
Swindon	,, 2	323	— 66	40	7,068	— 652	4·4	..
Tyneside	,, 9	679	+ 1	52	23,678‖	+ 2,368	8·87	..
Walthamstow	,, 12	845	+ 115	41	23,821	..	9	..
West Ham	,, 10	4,220	+ 802	41	92,978	+17,963	14·7	+ 1·4
Wolverhampton	,, 9	1,450	— 70	40	34,68‖	+ 1,505	12·5	..
Yorks. W. Riding	,, 13	2,000	+ 615	2	2,000	..	..	..
Baker St.-Waterloo	,, 12	4,730	..	2	4,730	..	3·75	..
Cen. London Rly.	,, 12	12,857	—1,198	2	12,857	— 1,198	6	..
City & S. Lon. Rly.	,, 13	6,284	+ 89	2	6,284	+ 89	6·25	..
Dublin-Lucan Rly.	,, 11	148	— 11	2	148	— 11	7	..
G.N. and City Rly.	,, 12	3,835	+ 7	2	3,835	+ 7	3·5	..
G.N., P'dy. & Bromp.	,, 12	6,990	..	2	6,990	..	9	..
L'pool Overh'd Rly.	,, 13	2,846	— 14	2	2,846	— 14	6·8	..
Mersey Railway	,, 12	3 655	+ 84	2	3,655	+ 84	4·5	..
Metropolitan Rly.	,, 13	31,648	..	2	31,648	..	70·5	..
Met. District Rly.	,, 13	15,860	— 616	2	15.860	+ 616	24	..
Anglo-Argentine	,, 14	34,801	+4,708	52	803.906‖	+95,099	43	..
§Auckland	Dec. 7	10,325	+ 430	49	119,887	+ 7,817	19·24	+ ·6
§Brisbane	,,	13,491	+1,081	..	..	..	..	..
§Brit. Columbia Rly.	Nov.	20,084	+5,941	22	101,258	+18.188	..	..
Bu'n's A'r's E.T.Co.	Dec. 15	3,248	+ 652	..	70,108	+10,899	24	..
Bu'n's A'r's Bigr'no	Jan. 6	3,320	+ 402	52	191,192‖	+10,867	..	..
Calcutta	,, 12	3,822	+1,398	..	..	..	..	..
§Cape Electric T. Ld.	Nov.	14,396	..	..	..	..	..	..
§Geneva	,,	7,213	+ 291	..	..	..	..	..
§Kalgoorlie, W.A.	Dec.	4,457	..	52	51,118	..	20·5	..
Madras	Jan. 15	1,150	+ 203	52	23,229‖	+ 2,806	12 75	+ 3·5
§Lisbon	Nov.	5,282	..	..	..	..	..	..
§Mexico	Sep.	4,400	..	..	..	..	..	..
Perth(W.A.)	Jan. 11	726	+ 124	52	76 809‖	+ 4,121	24·25	+ 5

Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.
‖ Total for the year 1906.

STOCKS AND SHARES.

Tuesday Afternoon.

INVESTMENT business is certainly more active than it was, say a month ago. The Stock Exchange settlement concluded on Wednesday proved a very useful send-off to what members (for their clients' sake) trust will really prove a prosperous year, and although the movements in prices are not great, and Consols keep merely firm, the increase in the volume of orders is considerable. The 6 per cent. Bank Rate is still with us, with hopes raised weekly for its decline and fall, but the faith is not sufficiently strong to counteract the extremely solid and unpleasant presence of dear money.

The first of the Home Railway dividends declarations for the latter half of 1906 made their appearance to-day. The earlier came from the Metropolitan Railway, and is at the rate of 10s. per cent. per annum, with £6,000 forward. This compares with 2¼ per cent. a year ago, and a carry-forward nearly twice as much. But the declaration had been discounted, and the price is still 58. The City and South London dividend, at the rate of 2 per cent., an improvement of ¼ per cent., was up to expectation, and the price keeps at 44. Districts are 19. It is expected that the dividend on Central Londons will be 4 per cent. all round, but the announcement may be out before these notes are.

Much interest was aroused by the British Westinghouse meeting, at which the proposals for reduction of the capital were passed, after a certain amount of opposition. The quotations for the Preference shares and the Debenture stock—1⅝ and 73 respectively—are unchanged. Both of them are tolerably nominal. Mr. J. Annan Bryce, the chairman at the meeting, did not reply to a shareholder's inquiry as to why other English electrical firms had managed to pay good dividends, despite the German competition, while the British Westinghouse could not pay the dividend on its Preference shares.

Cromptons are $\frac{5}{16}$ better at $2\frac{1}{16}$, and the Debenture stock is a point up at 95½. This is the principal move in the manufacturing list. Castner-Kellners advanced a few pence to 1⅛, and British Insulated Preference hardened to 6.

Edmundson's are flat in the Electricity Supply section. The Ordinary fell 15s., to about 45s., and the Preference at 4⅜ went 5s. lower. This was accompanied by a drop in Urban Ordinary shares, which are now called 2⅜ to 3¾. Of course, for some time past the market in the Ordinary of both companies has been a bad one, attention being drawn to the fact upon several occasions here. The interim dividend of the Ordinary shares has been passed. Other fluctuations are few. St. James' and Pall Mall Ordinary gave way 1 to 9⅜, and Smithfield gained a similar amount at 2. Westminster Preference at 5½ show ⅛ improvement, and Chelseas are ⅛ lower.

Speculation upon the probable amount of the Anglo-American Telegraph dividend on the Deferred stock tended to keep the market lively, and the result so far is a gain on the week in the Preferred as well as the Deferred stock. This market is good all round, the feature being a jump of £2 a share in Great Northerns, which are now 38½. The Eastern group has several advances, and Western Telegraphs at 14 are firmer. The dividend on Direct States is 4s. a share, with the exceptionally good carry-forward of £17,000. Even Marconi's are $\frac{1}{16}$ up, at 18s. 9d. Globe Ordinary rose to 10½ and Reuters to 7¾.

Renewed optimistic prophecies concerning the National Telephone Company's report made the stocks improve again, the Preferred adding 2, at 111. The Deferred and 3½ per cent. Debenture stocks rose ¼ and 1 respectively, and the Third Preference shares half-a-crown. Monte Video Preference firmed up to nearly a pound.

In the Traction group, strength continues to characterise some of the Argentine companies' shares. Anglo-Argentine Ordinary and Preference are ⅛ and $\frac{1}{16}$ better, but Belgrano Ordinary lost ⅛ of their 10s. rise last week, although the "B" Preference improved to 5¼. A denial has been given that the report that an international Trust is to take over the various Argentine tramway concerns, but this does not preclude a general agreement between the undertakings. British Electric Traction Preference receded another 2s. 6d, which lowered the price to 8⅛. On the other hand, London United Preference at 9 are 5s. better than they were a week ago.

Direct United States Cable Co., Ltd.—An interim dividend of 4s. per share (at the rate of 4 per cent. per annum) for the quarter ending December 31st, 1906, is payable on and after the 31st inst. A balance of about £17,031 will be carried forward.

Change in the Bank Rate.—The Bank rate was yesterday reduced to 5 per cent.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Jan. 8th.	Closing Quotations Jan. 15th.	Business done week ended Jan. 15th, 1907. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil.	Nil	..	..	8 — 8½	8 — 8½	..	..	..
149 800	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	..	88 — 91	88 — 91	..	..	..
660,660	Anglo-American Telegraph	Stock	6½.	2½%	3½%	..	68 — 70	68 — 70	68	..	..
3 169,670	Do. do. do. 6 % Pref.	Stock	6 %	6½%	6 %	..	109½ —110½	110 —111	110⅜	109⅜	+ ⅜
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	⅛%	..	27⅞ — 27⅞	27⅞ — 27⅞	27 15/16	27⅞	+ ⅛
60,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6¾ — 7¼	6¾ — 7¼	7	..	..
2,097,680	Commercial Cable Stng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	..	96 — 98	96½ — 98½	98	97½	+ ⅜
16,000	Cuba Telegraph	10	10 %	5 %	5 %	..	8¼ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	5 %	10 %	10 %	..	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	8⅝ — 8¾	8⅝ — 8¾	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	9 — 9¼	9 — 9¼	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	..	£8 —101 xd	98 —101	..	..	..
60,710	Direct United States Cable	20	3 %	3½%	4½%	..	16⅜ — 16½	15⅞ — 16⅛	16⅛	15 13/16	+ ⅛
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..
4,700,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —140	137 —142	140½	137⅜	+2
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	..	86½ — 88½	86½ — 88½	87⅛	86⅜	..
1,596,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	105 —107	105 —107	105	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13⅜ — 13⅝	13⅜ — 13⅞	13⅝	13⅜	+ ⅛
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	105½ —107½	106 —108	107½	107	+ ½
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	..	99½ —101½	99 —101 xd	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	99 —101	99 —101	..	..	..
181,127	Globe Telegraph and Trust	10	5½%	5⅝%	5½%	..	10 — 10⅞	10⅛ — 10⅜	10 3/16	10⅛	+ ⅛
181,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	..	14 — 14½	14 — 14½	14⅜	14 5/16	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	..	25½ — 27½	27½ — 29½	26⅝	..	+2
33,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	..	58 — 60	58 — 60	59	..	..
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	1/16 — 1/16	⅛ — 1	20/-	19/4½	+ 1/16
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	4 %	5 %	..	1 — 1⅛	1 — 1⅛	22/-	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	31/32 — 1 1/32	..	..	+ 1/16
2 225 000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	..	108 — 110	111 —112	110	108⅜	+2
2 225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	..	109 — 111	110 —112	110½	109½	+1
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	..	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	..	10 — 12	10 — 12	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	..	5⅜ — 5⅝	5⅛ — 5⅜	5 3/16	5⅛	+ ⅛
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	..	95⅛ — 97⅛	96 — 98 xd	96⅜	..	+ ⅛
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	100 —102	100 —102	102	100½	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6½%	6½%	7½%	..	1½ — 1⅝	1½ — 1⅝	26/3	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1⅜ — 1½	1⅜ — 1½	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	..	95 — 97	95 — 97	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	..	98 —101	98 —101	..	..	..
11,889	Reuter's	8	5 %	5 %	5 %	..	7½ — 7⅞	7⅞ — 8	..	..	+ ⅛
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	..	99 —102	99 —102	..	..	..
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	126 —129	126 —129	..	..	..
80,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛ xd	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	..	108 —111	108 —111	..	..	..
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	..	10 — 10½	10 — 10½	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	98½ —101½ xd	98½ —101½ xd	..	..	..
907,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13⅝ — 14⅛	13⅞ — 14⅛ xd	14⅛	13⅞	+ ⅛
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	99½ —102½	99 —102	101½	101	— ½
88,321	West India and Panama Telegraph	10	Nil	Nil	..	..	⅛ — ¼	⅛ — ¼	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	..	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	..	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY,¶ MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	..	7 1/16 — 7 1/16	7⅞ — 8⅛	8 1/16	7⅞	+ 1/16
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5 %	5 %	5½%	..	5 5/16 — 5 7/16	5⅝ — 5⅞ xd	5⅞	..	+ 1/16
266,800	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	..	139 —139	136 —139	..	..	..
985,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	..	104 —106	103 —106	..	..	— ½
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20 %	20 %	..	3⅞ — 4⅛	3⅞ — 4⅛	81/3	78/9	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1 1/16 — 1 3/16	1 1/16 — 1 3/16	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	6 — 6½	6 — 6½	6½	6⅛	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	..	6¼ — 6⅝	6⅜ — 6⅝	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5¼ — 5⅝	5¼ — 5⅝	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4¼	4 — 4¼	..	..	..
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	101 —105	101 —105	103⅞	102½	..
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	..	100 —103	100 —103	..	..	..
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	..	129 —134	129 —134	132	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	110 —114	110 —114	112	..	..
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	108 —112	108 —112	110⅞	110½	..
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	..	102 —105	102 —105	..	..	..
200,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	..	103 —106	103 —106	105½	..	..
183,301	British Electric Traction	10	6 %	6 %	3 %	..	4⅛ — 4⅜	4⅛ — 4⅜	90/7½	86/3	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	8 — 8⅛	7⅞ — 8⅛	8⅛	8	— ⅛
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	108 —111	108 —111	109½	..	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	85 — 88	85 — 88	86⅛	85½	..
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	..	6¾ — 7	6¾ — 7	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅝ — 6⅛	5⅞ — 6⅛	..	..	+ ⅛
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	..	100 —103	100 —103	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	94 — 98 xd	94 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1⅜ — 1⅝	1⅜ — 1⅝	30/6	28/1½	..
1,018,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	..	71 — 75 xd	71 — 75 xd	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	..	..	1/16 — 1/8	1/16 — 1/8	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	..	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	..	¾ — 1	¾ — 1	..	..	..
150,000	Do. Non-cum. 6 % Pref... ..	2	6 %	6 %	6 %	..	1⅜ — 1⅝	1⅜ — 1⅝	31/10½	..	..
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	..	95 — 97	95 — 97	..	..	..
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	..	80 — 83	80 — 83 xd	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	8 %	4 %	8 %	..	3⅞ — 4	3⅞ — 4⅛	75/-	68/1½	— ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	..	5¼ — 5⅝	5¼ — 5⅝	5⅜	..	..
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	..	4½ — 5	5 — 5⅜	5⅜	..	+ ⅛
313,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	..	104 —106	104 —106	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	..	101 —104	101 —104	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	6 %	8 %	8 %	..	7⅞ — 8⅛	8⅛ — 8⅜	8⅜	..	+ ⅛
82,610	Do. 105,001 to 137,610	5	..	..	8 %	..	7⅞ — 8⅛	7⅞ — 8⅛xd	..	..	+ ⅛
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,390	..	..	..	..	..	5¼ — 5⅝	5¼ — 5⅝	5⅜	..	..
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	..	103 —106	103 —106	106	103⅜	..
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	..	9¼ — 10⅛	9⅜ — 10⅛	10⅛	9⅜	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	6¼ — 6⅝	6⅜ — 6⅝	5⅝	5⅜	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	..	106 —108	106 —108	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	7/16 — 9/16	7/16 — 9/16	1/3	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	23/3	22/6	+ 1/16
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	101	100⅜	..
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	..	82 — 84	82 — 84	82	..	..
544,216	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	..	98 —100	98 —100	..	..	..
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	71 — 74	72 — 75	73⅛	..	+ 1
1,480,000	City and South London Railway	Stock	2¾%	3½%	12½%	2½%	43 — 45	42 — 44	44⅛	44	..
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	2½%	2½%	..	1⅜ — 1⅝	1⅜ — 1⅝	41/3	..	— ⅛
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	93 — 96	94 — 97	..	..	+1

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Jan. 8th.	Closing Quotations Jan. 15th.	Business done week ended Jan. 15th, 1907. Highest	Lowest.	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1 7/16 — 1 1/8	1 7/16 — 1 1/8	..	..	..
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	6 %	6 %	6 %	..	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	101 —104 xd	101 —104	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6¾%	6 %	6 %	..	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	2½%	4⅜%	..	1 1/8 — 1 3/8	1 3/8 — 1 1/2	..	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	2½%	4⅜%	..	2 1/4 — 2 3/8	2 1/4 — 2 3/8	..	..	..
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	£5 — 87 xd	£5 — 87	..	..	..
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	4 %	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1 1/8 — 2	1 1/8 — 2	..	..	..
300,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	..	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	5/8 — 11/16 xd	5/8 — 5/8	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	..	94 — 97	94 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	8 %	4 %	4 %	..	3 1/4 — 3 3/8	3 1/4 — 3 3/8	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10 1/2 — 10 3/4	10 1/2 — 10 3/4	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	..	11 — 12	11 — 12	11 11/16	..	..
900,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5 5/16 — 5 3/8	5 5/16 — 5 3/8	..	..	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	..	106 —108	106 —108	107	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10%	5 %	10%	..	15½ — 16½ xd	15½ — 16½xd	..	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1¾%	1½%	Nil	..	1 1/8 — 1 1/8	1 1/8 — 1 5/8	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	..	6 — 7	6 — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	8 %	6 %	3 %	..	7 1/2 — 8	8 3/8 — 9 1/4 xd	..	..	..
399,930	Do. do. 60,008 to 100,000 (£6 paid)	10	8 %	6 %	3 %	..	3 1/4 — 4 1/2	3 1/4 — 4 1/2	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	..	8 1/4 — 9 1/2 xd	8 1/4 — 9 1/2 xd	..	..	..
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	86 — 91 xd	85 — 89	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	3	..	1/16 — 1/8	1/16 — 1/8	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1 5/8 — 1 3/4	1 5/8 — 1 3/4	17/-	16/3	..
850,000	Do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	..	95 — 98 xd	95 — 98	..	..	..
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	..	4 1/16 — 4 1/8	4 3/16 — 4 1/4	..	..	..
24,500	Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500	10	5 %	5 %	4 %	..	6 — 7	6 — 7	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	5 %	5 %	5 %	..	7 — 8	7 — 8	..	..	..
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	98½—10 1/2	98 1/2 —101 1/2	..	..	..
87,850	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	..	30 — 32	30 — 32	..	..	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	..	99 —102 xd	99½—102½ xd	100¾	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	..	89 — 91	89 — 91	..	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1 — 1½	1 — 1½	..	..	..
66,666	Do. 6 % C. P., 80,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3 — 3½	3 — 3½	66/3	62/6	..
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	73 — 78	73 — 78	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5½%	4 %§	..	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	..	8 — 9	8 — 9	..	..	..
10,102	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7⅜ — 8	7⅜ — 8	..	..	..
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	..	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	..	3 1/2 — 4 1/4	3 1/2 — 4 1/2	73/9	..	..
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4 1/2 — 4 3/4	4 1/2 — 4 3/4	..	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	3 3/4 — 4	3 3/4 — 4	..	..	..
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	100 —103	100 —103	99½	..	..
49,436	Chelsea Electricity Supply, Ord.	5	5⅛%	6 %	6 %	..	5 1/8 — 5 3/8	5 — 5 1/16	5 1/16	..	— 1/8
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	..	104 —107	104 —107 xd	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	..	9 1/4 — 10 1/2	9 1/2 — 10 1/2	10 1/32	10 3/32	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	11 — 12	11 — 12	..	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	..	121 —124	121 —124 xd	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	..	98 —101	100 —103	..	..	+2
40,000	County of Durham Electrical Power, Ord.	2	4 %	£3 7 0	4 %	..	2 1/8 — 2 3/16	2 1/8 — 2 3/16	..	..	..
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	..	4 3/8 — 5 1/2	4 3/8 — 4 1/4	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	..	7 1/4 — 8 1/2	7 1/2 — 8 1/2	..	..	..
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10 1/2 — 11 1/2	10 1/2 — 1 1/2	..	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	..	105 —108	105 —108 xd	107 3/4	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	..	98 —101	98 —101	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	..	2 1/4 — 3 1/4	1 3/4 — 2 3/4	..	..	— 3/4
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	4 3/4 — 5 1/2	4 3/4 — 4 3/4	98/9	..	— 3/4
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	..	98 —101	97 —100	..	..	—1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	5 1/2 — 5 5/8	5 1/2 — 5 5/8	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	..	4 1/2 — 5 3/8	4 1/2 — 5 3/8	..	..	..
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	..	99 —102	99 —102	..	..	..
18,000	Hove, 1 to 18,000	5	8½%	8½%	9 %	..	7 1/2 — 8 1/4	7 3/4 — 8 1/4	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	..	9 1/4 — 10 1/2	9 1/4 — 10 1/2	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	..	1 1/2 — 2 3/8	1 1/2 — 2 3/8	..	..	..
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4 3/4 — 5 1/2	4 3/4 — 5 1/4	..	..	..
574,295	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	..	95 — 98	95 — 98	96	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	..	7 3/4 — 8 1/4	7 1/4 — 8 1/4	First 7 3/4	7 1/2	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	..	5 1/4 — 5 3/8 xd	5 1/4 — 5 3/8 xd	5 5/16	..	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	..	106 —110	106 —110 xd	..	..	..
250,000‡	Do. 3¾ % Mort. Deben. Stock Redeem.	Stock	3¾%	3¾%	3¾%	..	94 — 96	94 — 96 xd	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	..	96 — 99	97 —100 xd	99	..	+1
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	..	7 3/8 — 8	7 3/8 — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	..	5 3/8 — 6 1/8	5 3/8 — 6 1/4	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	..	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	..	97 —100	97 —100	..	..	..
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6¾%	7 %	7 %	..	6 — 6 1/2	6 — 6 1/2	..	..	..
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	..	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	..	9 1/4 — 10 1/2	9 1/2 — 10 1/2	..	..	— 1/4
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	..	7 — 8	7 — 8	..	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	..	94 — 96	94 — 96 xd	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	..	1 1/2 — 2 1/4	1 1/2 — 2 1/2	35/-	..	+ 1/4
50,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	73 — 77	73 — 77	..	..	..
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	..	2 3/8 — 3 1/8	2 3/8 — 3 1/2	..	..	..
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	..	1/8 — 3/8	1/8 — 3/8	..	..	..
117,968	Do. Do. 7 % Pref.	1	7 %	7 %	7 %	..	1 1/8 — 1 3/8	1 1/8 — 1 3/8	26/-	..	..
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	..	102 —105	102 —105	103	..	..
60,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	3 1/2 — 3 3/4	2 3/4 — 3 1/4	60/-	..	— 1/4
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4 — 4 1/2	4 — 4 1/2	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	..	99 —102	99 —102	..	..	..
‡10,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	..	9 — 10	9 — 10	..	..	..
81,279	Do. do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	..	5 1/8 — 5 3/8 xd	5 1/4 — 5 3/4	5 3/8	..	+ 1/8

Shares not officially quoted:—Mackay Companies, ord., 74—76. Pref. 70—72.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 6 per cent. October 19th. 1906.

PROCEEDINGS OF INSTITUTIONS.

Some Notes on the Breaking of Trolley Wires.

By P. S. Sheardown, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Dublin, December*, 1906.)

The author believes there has been no authentic case in England of anyone having received serious injury from coming in contact with a fallen trolley wire; the fatalities in Liverpool some few years ago were due to fallen telephone wires, in contact with the trolley wire, and not to a broken trolley wire.

In the case of trolley wire erected with the ordinary soldered cars, the wear is usually fairly uniform along the span until you come to the ear, where the wire close up to the ear will be found to be still more worn.

There are four actions taking place just at the critical spot where the wire joins the rigid suspension, all tending to weaken or deteriorate the material in the wire at this place, namely:—

1. The blow of the trolley wheel against the butt of the ear, part of which comes against the wire.
2. The effect of the sparking which occurs at the same place, and due to the trolley wheel losing contact with the wire.
3. The molecular change or crystalising action in the wire, due to what the author has termed the damping-out of vibration in the suspended wire.
4. The bending or hinging action due to the upward pressure of the passing trolley wheels.

And possibly a fifth, namely, overheating of the wire when being soldered.

In practically all cases of broken trolley wire the fracture takes place close to the point of suspension or to a splicing tube, where No. 4, the bending action, is very severe on the wire. After wire has been up a certain time it usually breaks first at the section insulators where it is held most rigidly, then at frogs and crossings, and finally at ordinary ears and at splicing tubes.

It is hard to ascertain how the weakening of the wire should be allocated among the causes mentioned, but even after the wire has been up many years, the weakening of the wire due to reduction of area is small. The author has on several occasions seen a well-worn trolley wire support the weight of a fallen tree, and has on more than one occasion seen as the result of a fallen tree, the wire torn from several suspensions and brought to within a few inches of the road without breaking.

On the other hand, some fractures have been experienced where the wire was suspended above cross-over roads which were practically never used, and where the wire was consequently subject neither to the blows, bending action nor sparking from passing trolley wheels, and the only action on the wire was that of vibration.

The author has seen many examples of trolley wire which have broken at a full-sized section; in one particular case a much worn section of wire was being taken down, one end of which terminated in a section insulator to which the wire was also anchored; when the anchoring wire was cut the trolley wire fell to the ground, and was found to be fractured quite ¾ in. up inside the nose of the section insulator, and may have been in this state for a long time, the anchoring wire having held the trolley wire in position.

The author can only recall, perhaps, two cases in which the wire appeared to have broken from a pure tensile stress; in these cases the section had pulled out thin before fracturing.

When it is proved that molecular stress or change in the wire caused by vibration and bending, has in practice much more to do with the breaking of trolley wire than tensile strains, certain conclusions may be drawn which hitherto have not received full recognition:—

First. In drawing up a specification for trolley wire, there is not very much object in asking for a very high tensile strength only; what is required is some guarantee that it will be able to withstand in practice the bending and vibration stress it will have to meet.

The presence of an alloy has a marked effect, and in this respect a composite wire known as phono-electric trolley wire gives remarkably good results. On the system with which the author is connected the trolley wire on certain routes, where it was subject to very hard wear, within two years of erection was breaking so often that it was replaced by phono-electric wire. This latter wire has now been up about six years, and only two breaks are on record. There are only two disadvantages to this make of wire: first, it is somewhat dearer than hard-drawn copper, and secondly, its electric conductivity is less than half that of copper.

The second conclusion is that trolley wire should be so erected that there is smooth under-running for the trolleys, and, if possible, it should be so suspended that vibrations in the wire should be free to travel the whole length of the wire, and not hung so that, as far as vibrations are concerned, each span is insulated from the next, the vibration in each span of trolley wire being damped out at the adjacent ears. The catenary system would appear to be a capital method on which to erect trolley wire; the author made some experiments in this direction, but there is considerable difficulty to be overcome in ordinary street work where there are many curves.

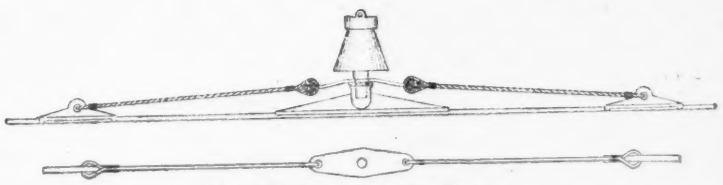
The third conclusion to be drawn is that cars should be run with as little upward pressure of the trolley wheel against the wire as possible, in order to reduce the hinging action at the ears; with this action in mind, the author is of opinion that trolley wire, especially when run from span wires, should be erected fairly taut, and the span wires left on the slack side, but he does not think the short so-called flexible suspensions on bracket arms are of much assistance except that they enable you to have better secondary insulation.

The fourth conclusion is that other things being equal, we are not likely to get a very much longer life, before breaking sets in, from heavy wire in comparison with light wires, say, 0000 compared with 0.

Lastly, as the fracturing referred to gives practically no external evidence that it is going to occur, indeed, in many cases it takes place just inside the butt of the ear, or under the frog clamps, careful inspection is of very little use, and the question to be asked on existing systems is what is best to be done, as naturally no one wants to renew the wire until wear makes it absolutely necessary.

The best way out of the difficulty in the author's opinion, and the one which he has adopted throughout the Dublin system, is to anchor the wire at all suspensions after it has been up two years, and at section insulators to anchor it at once.

Anchoring the wire at section insulators, frogs and crossings, is a comparatively simple matter; all that is required is a half-anchor ear and a piece of galvanised wire, as there is no difficulty about finding a place to anchor the wire firmly to on some part of the section insulator or frog. But when it comes to anchoring at the ordinary ear suspension, the matter is not so simple; if special anchor ears were not put up in the first instance, one method would be to anchor to the span wire or bracket arm, but this would mean the cost of nearly double the number of insulators throughout the system, to say nothing of the fact that the more insulators you have on a job, the greater the chance of trouble with them. The arrangement which the author has adopted, is known as the "K. Q." patent anchoring device. It was designed by two of his assistants, and is at once cheap in first cost and simple to put up. It consists essentially of a stamped steel plate with a hole in it, through which the threaded portion of the insulator bolt passes; the plate, to which the anchor wires are fastened, is thus securely held in position on top of the ear, but the strain of a broken wire comes direct on the bolt. The cost of this arrangement erected complete is about £14 per mile of double track.



"K. Q." Patent Anchoring Device.

The half-anchor ear if properly designed will have a sufficient grip of the wire and yet give smooth under running. Moreover, it is much shorter than an ordinary ear, and is free to move with the wire instead of itself being fastened to a support. In Dublin, anchoring has been employed at section insulators for about eight years, and at the present time every suspension is anchored except where the wire has been recently renewed. There are, therefore, about 8,000 of these half-anchor ears in use, but on only two occasions has the wire failed at a half-anchor ear.

When the wire breaks at a suspension the anchoring device holds it in position, and as soon as it is noticed the emergency wagon is sent for, and the men quickly make a temporary repair; beyond the fact that a few trolley wheels may leave the wire, no inconvenience or stoppage to traffic is experienced, and although as many as 20 broken wires per month have been reported during the past 12 months, only three have come to the ground. In one case the suspension was not anchored, in another the wire was held in the anchor all right but was afterwards pulled down by a trolley head getting caught, and in the third case the wire broke outside the anchoring device.

Discussion.

Mr. A. E. Porte said he had noticed a crystalline formation after overhead wires had been in service some time, which, he thought, might be due to changes in temperature or vibration. The speaker referred to a copper plate which he had cut out of a fire-box of a boiler which had been in use some eight years, and there was marked crystallisation, which rather went to prove that similar action took place in copper wires.

Mr. T. Tomlinson suggested that many breakages of trolley wires occurred owing to the wires being soldered into the ears. The fact that most breakages occurred in or close to the ears gave support to that view.

Another speaker also suggested that the breakages were due to overheating during the soldering process. He had found numerous breakages occur in telegraph and telephone wires, and the breakages almost invariably occurred near a soldered joint, the wire being brittle at that point.

Mr. P. S. Sheardown, in reply, said that it should be remembered that trolley wires were run in a different way to ordinary wires, and that the stresses which occurred were of quite a different nature. The action was very much worse, as trolley wires were practically rigid as compared with telephone wires. The action of the trolley se

up a vibratory movement, and at the instant the trolley passed the ear, the tendency was for the trolley to damp out the vibrations setting up a condition of affairs analogous to the bending of a piece of wire backwards and forward, one end being held in a vice. This vibration had a worse result near, and at, the ears, as the line was much more rigid at the ears than in the centre of the span, and the fact that most breakages occurred in, or close to, the ear supported that view. The effect of soldering the wires into the ears probably might have some effect on the wire, but at the same time his experience was that breakages most frequently occurred at section insulators where mechanical supports were used, and no solder, which, on the other hand, rather tended to disprove the heating theory.

The Track Circuit as Installed on Steam Railways.

By H. G. Brown, Associate Member.

(*Abstract of Paper read before the* Institution of Electrical Engineers *in London, December 20th*, 1906.)

Experience has shown that the track circuit not only affords a greater degree of safety, but also that its use permits a closer headway, and therefore a greater traffic capacity, at a smaller maintenance cost than any other system. As a means of automatically informing the engine driver of the condition of the section of line to which it gives admission, it is undoubtedly the best, because it is operated by the presence of the train itself upon the metals.

It is a fundamental principle in signalling that the failure of any part of the system should result in the signal going to danger. In designing the circuits, therefore, each scheme of connections must be carefully analysed to determine the probable effect of the earthing and short or open circuiting of every instrument and wire.

The principle upon which the track circuit is operated differs from that governing the majority of electrical combinations. In railway signalling, as well as other applications, the opening or closing of electrical circuits, as a general rule, gives the signals, but the condition of the track circuit is indicated, not by the opening or closing of the circuit, but by forming a shunt across the relay, reducing the potential drop to a point below that required for its operation.

The circuit is formed by the battery (fig. 1), track rails and relay in series. The battery is connected between the rails at the end, and the relay at the beginning of the section, the end and beginning being determined by the direction of traffic. The current flows from the battery through the entire length of the section on one rail, through the relay, and back to the battery through the other rail. The section of line included in the track circuit is isolated by means of insulated fish-plates. All rail-joints except those separating the sections from each other, are bonded to ensure electrical continuity.

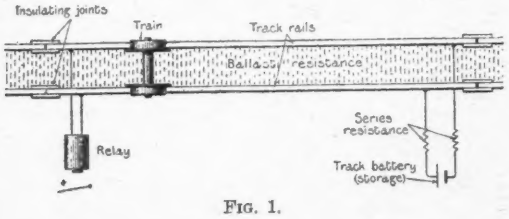


Fig. 1.

The actual resistance of the ballast and sleepers is low, especially in long track sections. It sometimes falls below that of the relay itself, and therefore the latter obtains but a portion of the total current, the rest leaking across from rail to rail. The average resistance per 1,000 ft. depends on local climatic conditions and the materials employed in the construction of the permanent way. Broken stone makes the best and cinders the worst ballast from the signal engineer's point of view.

There are therefore two, and when the section is occupied three, resistances in parallel, namely, the relay, the ballast, and, in the latter case, the shunt formed by the train. These parallel resistances are in series with the internal resistance of the battery or its equivalent in effect. The resistance of the rails in properly installed short track circuits should be negligible.

The fact that the working of the circuit is dependent on the variation in the resistance between the rails, points to the necessity of a resistance external to the track but in series with it. This series resistance plays a most important part, for if the battery had no internal resistance, or if its equivalent were omitted, the full potential would be maintained across the relay no matter how much the resistance between the rails might be reduced by a train occupying the section.

Effective shunting is the main question. The shunt formed by an engine and train has a resistance so low as to be without interest, but if formed by a light single vehicle the resistance is sometimes relatively high, on account of the smaller contact surface and pressure between the rails and the wheels.

Rolling stock, as regards shunting effectiveness, may be approximately divided into two groups, namely, trains and engines, and single wagons, and an arbitrary resistance assumed for each class, high enough, with a factor of safety, to exceed the maximum obtained by actual tests. In the case of coaches fitted with ordinary Mansel wheels the hubs and tires must be bonded.

The maximum resistance that will shunt a given track circuit bears a definite relation to the ballast resistance which would cause the relay to drop its armature. It also varies inversely with the variation of the ballast resistance above the failing point. If the shunt is to be effective the combined resistance of the ballast and the shunt must be equal to or less than that of the ballast resistance only at which the track is adjusted to fail. The resistance of the relay, being constant, does not affect the relation between the effective shunt and the ballast resistance for a given adjustment.

The first factor to be considered is the minimum ballast resistance. The next, the maximum, and the range between the two. The third, the resistance of the poorest shunt which will be effective. This latter is settled by the first two factors—no matter what the resistance or pick-up volts of the relay may be.

The resistance of the relay is largely a question of economy in operating power and of its adaptability to the battery arbitarily selected. Its function is to open or close local circuits which control a signal either directly or indirectly, by working the various devices used in the interlocking of points and signals. It should be a well made and efficient instrument, as but little power is generally available for its operation. On steam railways a relay should work with not more than 0·015 of a watt. On electric railways, on account of the presence in the track rails of extraneous currents of some magnitude, it may be advisable to maintain a higher potential between the rails than would otherwise be necessary, and to employ a less delicate instrument on account of the risk of its being subjected accidentally to the full potential of the motive power service.

There are, broadly speaking, two kinds of relays. The neutral type is uninfluenced by the polarity of its field. The polarised relay has an additional armature which is polarised and operates contacts selectively in response to the polarity of the current energising its magnets. One of the many uses of the polarised relay is to operate distant signals by means of the reversal of the track circuit, thereby rendering unnecessary the line wires which with the neutral type of relay would be required between the distant or caution signal and the stop signal controlling it.

The potential required to operate the relay increases with its resistance, and although the current in the relay is decreased, the total current in the circuit and therefore the total watts are increased, as the ballast resistance does not vary with that of the relay.

The relay contacts are operated by means of the movement of an iron armature. The air-gap in the de-energised position is greater than when the relay is energised and its armature has responded. For this reason the potential required to pick up the armature is greater than that required to hold it up. The range in potential between the armature pick-up and drop should be as little as possible, and is in actual practice approximately equal to 30 to 50 per cent. of the pick-up volts. It is important that the armature bearings should be practically frictionless and the contacts constructed so that there is no risk of their fusing together. The armature itself should be prevented from actually touching the pole pieces on account of the possibility of the presence of residual magnetism. Any neglect of these points might result in keeping the armature in the energised position at the wrong time, with possibly disastrous consequences.

Front contacts are closed when the relay is energised and are platinum to carbon, the movable members being platinum and the stationary ones carbon.

Bottom or back contacts are closed when the relay is de-energised, and are generally platinum to platinum.

A battery having a constant potential and internal resistance should be used. The Daniell gravity battery was at first almost universally employed; it has, however, an extremely variable internal resistance.

On the other hand, the storage battery has much to recommend it. Its internal resistance being low, it is necessary to use an additional external resistance in series with it, the value of which may be altered to suit local conditions as accurately as desired. Its potential difference is fairly constant, and need not vary more than 10 per cent. In many cases it is more economical from the maintenance point of view, although its first cost is greater. As its electrolyte has a much lower freezing point than the zinc and copper sulphate solutions in the gravity battery, a deep battery well is unnecessary for protection from cold.

Two bonds should be used at each joint on account of their liability to break, and also in order to reduce the total bond resistance. No. 8 S.W.G. galvanised iron wire may be used under ordinary conditions.

The insulating wooden joint consists of two heavy oak blocks bolted to the rails, one on each side. The rail ends are separated by one or two pieces of ¼-in. fibre of the same shape as the rail section.

A track circuit should be adjusted to shunt, as well as to give a clear indication under the worst ballast conditions.

The phrase "Ballast resistance at which the track is adjusted to fail" may here be explained as follows:—

If the ballast resistance falls below the assumed minimum, it is evident either that extraordinary weather conditions exist or that there is some fault which forms a connection between the rails, supposing, of course, that the section is unoccupied.

The minimum ballast resistance is important only as a point at which the track potential must be sufficient to cause the relay to pick up its armature, thereby ensuring the continued working of the circuit. By virtue of the series resistance there is a resistance below the assumed minimum of the ballast, at which the relay will fail to pick up its armature on account of the attendant decrease of the track potential. The circuit may be adjusted so that this

minimum bears a safe and definite relation to the minimum ballast resistance, and one might say that this is the point at which the track is adjusted to fail.

This is important because it determines for all conditions of ballast resistance the maximum effective shunt, that is, the shunt resistance which in parallel with the existing ballast resistance will bring the track potential down to the failing point of the relay.

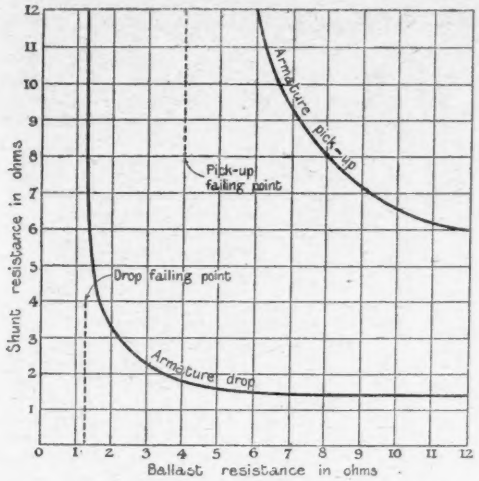


FIG. 2.

The relay has two failing points: the armature pick up and the armature drop. The adjustment must be such as to allow the armature to pick up with a margin at the minimum ballast resistance. A shunt to be effective must cause the armature to drop. It is evident that a shunt of lower resistance is required to drop the armature than is necessary to prevent its being picked up. In fig. 2, the top curve represents the shunt which will prevent the pick-up, and the bottom that which will cause the drop.

The diagram is based on the following figures:—A ballast minimum of 6 ohms and a relay having an armature drop point equal to one-half the pick-up potential. The track is adjusted so that the pick-up failing point will be reached if the ballast resistance drops to 4 ohms. The relay has a resistance of 4 ohms, a pick-up point of 0·2 volt, and a drop point of 0·1 volt. With a battery potential of 2 volts, a series resistance, including the internal resistance of the battery, of 18 ohms would be required.

The ends of these curves extend indefinitely in both directions, for at the failing point the effective shunt would be infinite, and

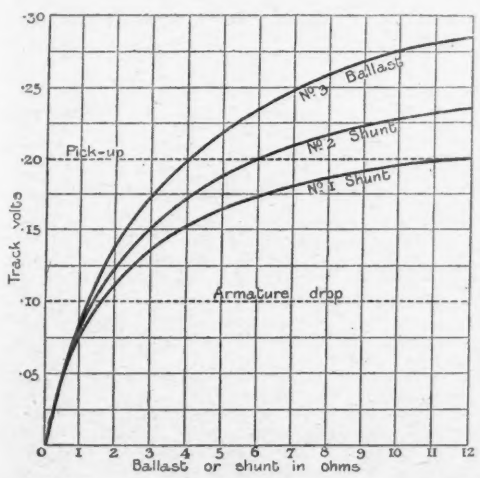


FIG. 3.

with an infinite ballast resistance it would equal the ballast resistance which would cause the relay to fail with the track unoccupied.

Curve 1, in fig. 3, shows the variation of potential due to a varying shunt with a ballast resistance of 6 ohms. Curve 2 shows the variation due to a varying shunt with a ballast resistance of 12 ohms. Curve 3 shows the potential with a varying ballast resistance, the section being unoccupied. The pick-up failing point is the same in fig. 2 as in the third curve in fig. 3.

I want to make one point very clear—namely, that if a track is adjusted to give a pick-up failing point at a certain ballast resistance or its equivalent, the maximum effective shunt at any ballast resistance is not altered by the resistance or pick-up volts of the relay used. If a track is adjusted to give a pick-up failing point at a certain ballast resistance with a 4-ohm relay, and an 8-ohm relay is used, the effective shunt will be greater at all ballast resistances; not through any virtue of the relay, but simply because, by its use without altering the series resistance, the pick-up failing point is reached at a higher ballast resistance.

With a pick-up adjusted for a given ballast resistance, the top curve would be the same for all relays. The position of the bottom or armature drop curve and its relation to the top curve will vary with the adjustment of the relay armature.

This armature adjustment may be obtained by decreasing the percentage variation of the armature air-gap, either by lessening the movement of the armature when adjusted near the pole pieces, or by increasing the minimum air-gap. With the type of relay in general use, the armature drop volts should be from 30 to 50 per cent. below the pick-up volts.

Relays should be adjusted and sealed by the manufacturer. This adjustment gives the best average results which can be obtained, and it should not be altered by the buyer unless he is sure of what he is doing. The minimum ballast resistance is, to a certain extent, under control, as it is approximately determined by the length of the circuit, but the relation of the minimum to the maximum depends on local conditions. Take the 6-ohm minimum in fig. 2 as an instance. This equals a 333-ft. circuit at 2 ohms per 1,000 ft., or a 2,000-ft. circuit at 12 ohms per 1,000 ft.

The shunt is the most important factor, and we will suppose that for a certain class of traffic a definite figure is decided upon. There is more than one way of adjustment, but the following method is productive of the most satisfactory results.

A relay and battery to be universally employed are chosen. The length of the circuit should be roughly determined by its minimum ballast-resistance per 1,000 ft., and the adjustment obtained by altering the amount of the series resistance.

In both methods the relay drop failing point should occur with a ballast resistance as close as possible to the minimum ballast resistance. Sufficient allowance should, of course, be made for the pick-up and the margin between the pick-up and minimum ballast resistance. The virtues of a track having a 4 or 5 ohm minimum are largely lost if the relay drop occurs at a ballast resistance lower than is necessary.

Where the conditions of traffic require a long block section and the nature of the track is such that it is undesirable to have a long track circuit, the section may be cut into two or more circuits, which collectively operate the one signal.

The measurement of resistances by substitution is often advantageous. The simplest manner of ascertaining the resistance required to shunt a track is to connect an adjustable resistance from rail to rail and gradually decrease its value until the relay armature drops. But in making tests with measuring instruments it must be kept in mind that the results obtained may need correction by calculation, because the conditions may be changed by the use of the instruments themselves, with the result that values are obtained different from those which existed before their introduction.

DISCUSSION.

At the conclusion of his paper Mr. Brown exhibited lantern views of the different apparatus referred to, as applied to the District and other railways. The discussion which followed did not add much to the information on the subject.

Mr. H. M. SAYERS, who opened the discussion, read a short communication from his brother referring to the possible insulation encountered with dirty tracks, where track circuits were used; he himself did not understand the small amount of energy expended in the relay, it should have sufficient power to ensure certainty in action. He asked the author if he had noticed any critical point in the pressure being maintained between the rails; from certain experiments with low voltage currents he thought this would be about 2 volts or so.

Mr. W. J. THORROWGOOD took exception to the term "ballast resistance," as an unnecessary innovation. In regard to interference from outside circuits, he pointed out that signal circuits on steam roads were subject to interference in the same way from neighbouring electric tramways. The use of alternating currents would get over the difficulty or proper means might be taken to prevent stray return currents in tramways.

Mr. E. C. IRVING, referring to the wooden block joint, mentioned that he had seen such a joint with a 2½-in. gap on a cold morning, owing to contraction of the rails. He thought they were no good on steam lines. A galvanised-iron bond, also, was better than copper, as it obviated electrolytic action to a great extent.

Mr. FRANK GILL remarked that there seemed no necessity to economise energy in operating the relays. He thought there was a lack of definite figures in the paper, and asked what was the ballast resistance in practice? He had seen long routes in the States equipped with automatic signals, and wanted to know how the apparatus was energised.

Mr. W. DUDDELL echoed the last speaker's remarks as to the lack of data in the paper; it appeared to him that there were many opportunities for disturbance of the track system which would interfere with the working of the relays; and

Mr. F. C. RAPHAEL remarked that continuity of action depended apparently on ¼ in. of fibre insulation.

Mr. BROWN, in his reply, referred to the excellent results obtained in everyday work, which, of course, necessitated the keeping of wheels, rails, &c., in good condition. There was no necessity on electric railways to restrict the energy used in relays, but on steam lines where the gravity battery was largely used, its small power, $\frac{5}{10}$ watt, required very delicate relays to be used, particularly as the condition of the ballast and track played such an

important part in the working. Price was also a point in connection with relays. He had not noticed the effect mentioned by Mr. Sayers. Referring to other points raised, rail resistance was equivalent to adding a series resistance in the track circuit; bond resistance was 70 per cent. more than that of the rails, and both joint and ballast resistance varied within very wide limits. The average minimum resistance was 4 to 18 ohms per 1,000 ft. of track, and this dropped to 1½ ohms in tunnels. The ballast resistance was, say, ¼ ohm. Wood joints were a moot point on railways. His system was not subject to trouble from extraneous currents, as the relays were so connected as to neutralise any effect of such current.

NOTES ON THE EVOLUTION OF CANAL ELECTRIFICATION METHODS.

By B. H. THWAITE, C.E.

Transport Efficiency and Industrial and Commercial Competition.—If evidence were required to demonstrate the keenness of modern international commercial and industrial rivalry, it can be found in the attempts that have been made within the last ten years in America, Germany, France and Belgium, to secure a reduction in cost of land, or internal transport of raw materials for, and the finished products of, manufacturing operations.

America, it may almost be said, has practically scrapped the whole of her rolling-stock, both traffic and passenger, that had the characteristics of early English railroad design. The object has been, as far as it related to the traffic rolling-stock, to cut down the ratio of the dead to the paying load; the system of efficiency measurement on the American railroads being the cost of transport per ton per mile, as distinct from the train-mile unit, the British method of test, which has really no efficiency value. The result of the American policy has been, as shown in the author's lecture before the London Chamber of Commerce in 1898, a very solid reduction in cost of transport, measured on the basis of cost per ton mile.

Germany is also following the American lead in searching for higher transport efficiency methods, and she is raising the carrying capacity of her State rolling-stock on German railways; but Germany's principal efforts in the direction of securing transport efficiency have been applied to her waterway methods of transport, on which, in the last few years, very many millions sterling have been expended.

The waterways of France and Belgium have also been extended, and Austria is showing her interest in waterway transport by her proposal to connect the Oder with the Danube by means of a great canal.

Neglecting the effect of tariff rates, it may be asserted that, all other things being equal, then the comparative industrial and commercial success of a nation will depend upon the efficiency and corresponding economy of its internal methods of transport. That to-day the difference in cost of transport in the great manufacturing countries is most marked will be seen by reference to the graphic diagram fig. 1, which is based on the authority of an American writer, Mr. E. P. North.

Neglecting the geographical position (by which Great Britain is so well favoured) in relation to the eastern markets, it is obvious that the Ocean service will eventually become cosmopolitan, and the rates on the ton-mile basis will tend to become equal (outside the effect of subsidies), so that it follows that the country possessing the most costly methods of internal transport, all other things being equal, will have the least chance of success in the world's markets.

Germany, Belgium, France and America are ever on the alert for improvements that will secure a substantial reduction in cost of internal transport, and in these countries important experiments have been made with a view to electrically operating canals.

In England the chronic *laissez-faire* influence has prevented, by the discouraging apathy of canal owners, any risk of capital in seriously demonstrating the practicability of displacing the horse by the electric motor or tractor, but the propaganda carried out by the author, by Mr. George Cawley, Mr. Stephen Jeans and others, over many years, has at last aroused public interest, and has resulted in stimulating the Government to institute an action of inquiry, represented by a special Commission on our canals, from which great hopes are entertained, and great improvements in our canal service are expected.

Canal Electrification—Early Attempts.—Several serious attempts have been made to electrify navigable waterways, but, as in the pioneering endeavours to apply electricity in other directions, the essential requirements to effect a satisfactory solution have not always been understood or recognised, and the results have consequently, in the majority of the applications, been failures, more or less.

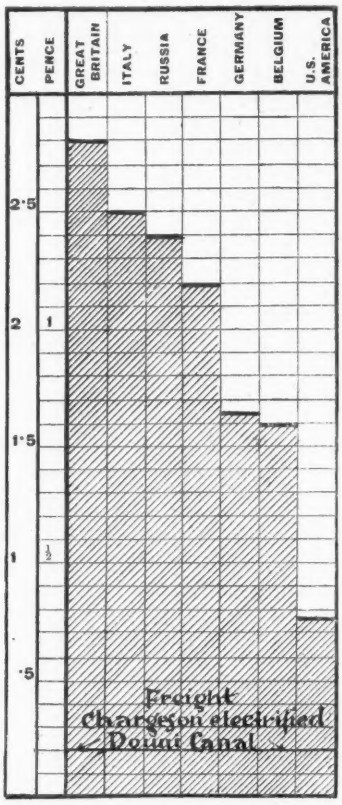


Fig. 1.—Diagram showing Average Cost of Transport per ton mile on Railways in the Countries named, and on the Douai Canal.

Even on the Continent with wide canals, and where the problem is far easier to solve than it is in our country, the canals of which have a comparatively small cross-sectional area, and a limited width of tow-path, and where the locks, tunnels and bridges occur at frequent intervals, the system of electrification is still in a comparatively experimental stage.

Synopsis of Canal Electrification Methods.—The systems of canal electrification, so far tested, may alphabetically be described as follows:—

A.—Screw propulsion by accumulators.

B.—Screw propulsion with current transmitted by trolley wire.

C.—Telpher motor tractor travelling on cables, supported by columns erected on tow-path.

D.—Electric automobile tractor running on the surface of the tow-path, current transmitted by trolley wire.

E.—Heavy electric tractor running on single-rail track on tow-path, current transmitted by trolley wire.

F.—Electric tractors running on a girder and rails, structure built on tow-path, rails superposed to permit double direction, adhesion partly by weight and partly by grip, set up by pull on tow-rope, current transmitted by trolley wire.

G.—Electric tractors running on directly superposed, and special-section girders, mounted on stanchions or posts, and independent of the tow-path, three-quarters of which can be removed for widening the canal, relying on pull of tow-rope for adhesion, set up by lever gear, current transmitted by rail—no trolley.

The systems alphabetically indexed as A, B, C and D have been tried and found wanting in some important particular, the real cause is not far to seek, and will be recognised in the tabulated analysis given below :—

*first mentioned.** Both systems have since been abandoned on that canal. As to accumulators, this means cargo, and I do not think it is 'at all one that we shall adopt in England.'"

Tabulated Synopsis, Setting Forth in a Condensed Form the Advantages and Disadvantages of the various Canal Electrification Systems.

System.	Advantages.	Disadvantages.	Other objections.
A	Will permit the towpath to be removed, and the consequent widening of the canal. Boats can pass through locks, under bridges and tunnels, without requiring other haulage assistance.	Loss of electrical energy in storage, weight of batteries, absorption of large space, and labour involved in renewal. Loss of propulsion energy by slip of screw propeller. Complete equipment heavy in cost and expensive to maintain.	Washing away of canal banks by effect of screw propeller. Boats require alteration, and the addition of screw propeller gear. Electrical energy not available for other canal services.
B	Will permit part of the towpath to be removed for widening the canal. Boats can pass through locks without requiring other haulage assistance.	Loss of energy by slip of screw propeller. Complete equipment will be a heavy cost and running costs heavy.	Washing away of canal banks by effect of screw propeller. Boats will require the addition of screw propeller gear. Not easy to apply trolley wire gear to some of the bridges and tunnels.
C	Electrical energy available for pumping, lighting, hauling, lifting, and warehouse and lock services. No loss by screw propeller slip. No alteration to existing boats. Small capital cost.	Part of existing towpaths must be retained. Cable too light for heavy haulage; slip effect must be serious. Liability to breakdown.	Additional haulage arrangements will be required for tunnels, &c.
D	All the advantages possessed by System C, except that it is not so convenient for haulage through locks. Small capital cost. 42 per cent. efficiency.	Existing towpaths must be retained. Weight of electric automobile tractor must be sufficient to provide adhesion, and extra haulage energy must be provided for this added weight. Friction of road surface heavier than that of rail, but less weight for adhesion required. Towpath road must be maintained in a high state of efficiency, and this means continual expenditure. Automobile tractor liable to be pulled into canal, in actual experience not an infrequent occurrence.	Ordinary British canal towpaths quite unsuitable for road tractor of this kind. Inapplicable for limited towpath provision of British canals, bridges and tunnels. Additional haulage arrangements will be required for tunnels, &c.
E	All advantages possessed by Systems C and D. Suitable for towage of heavily laden barges up to, and above, 600 tons burden. 63 per cent. efficiency.	Existing towpaths must be retained and strengthened. Weight of tractor must be adequate to provide necessary adhesion, which is greater than System D, for obvious reasons. Eight tons tractor weight is provided; this weight has to be hauled, whatever the weight, size and capacity of the cargo. Cost and maintenance of permanent railway, but obviously no appreciable wear on road surface of towpath.	High capital cost, both in permanent way and in rolling stock, generally inapplicable, except for open canals, or where the bridges are very high above water level. Not generally applicable to ordinary British canals, but might be available for short open lengths of the widest canals and other waterways.
F	All advantages possessed by Systems C, D and E. Suitable for towage of heavy burdens. Suitable for larger canals. Energy absorbed partly proportionate to haulage demand. 70—75 % or higher efficiency.	Existing towpath, or at least three-quarters of the present width, must be retained. Rather costly permanent gripway. Construction of demonstration plant unnecessarily heavy. Trolley wire equipment cost, in addition to permanent way.	Very high capital cost of permanent way, but tractors not so costly as in System E. This system is only applicable to the larger of the British canals. Additional haulage arrangements will be required for tunnels, &c.
G	Will permit three-quarters of the towpath to be removed, and the consequent widening of the canal. Will possess all the advantages of Systems C, D, E and F; exceptionally light dead load of tractor. Suitable for most of the Irish and British canal requirements. Energy absorbed in pull provides the proportionate adhesion. No trolley wire equipment necessary. Efficiency of 75 to 80 per cent. should be secured.	A quarter of the existing width of the towpath will be retained. Rather expensive in construction, but less than Systems E and F. High efficiency and convenience justify cost of system.	In some exceptional cases, special additional haulage arrangements for tunnels and bridges will be required.

The systems A, B, C and D have been tried in Belgium, France and the United States, and have been discarded.

The systems A and B were tested on the Charleroi Canal, Belgium. Mr. W. H. Bartholomew, C.E., who inspected the systems, makes the following statement in his published evidence given before the Canal Commission :—

"I inspected the Charleroi Canal, and went into the question there with the managers, and I was surprised to find that if the electric motor was put into the boat on the wire and trolley system, this brought the *cost up to horse haulage*, and that in the case of an electric-driven trolley (tractor) on the tow-path, the cost was about *one half the*

Each of the systems tried and abandoned was introduced with the usual fanfare of optimistic references; had those who were responsible for the systems realised the requirements to satisfy water-way transport exigencies, much disappointment would have been prevented.

The systems that have been put into practical operation with more or less success are those indexed D, E and F, the latter inadequately covering the system G.

* This one-half was obviously lost by the slip of the screw propeller.

The automobile tractor system D, although discarded on the Charleroi Canal, is still in use on the canals of d'Aire and Deule, at Douai, France.

(*To be continued.*)

OF TECHNICAL LITERATURE.

By W. M. M.

Not with blinded eyesight poring over miserable books.
—*Tennyson.*

On occasions, mostly after dinner, the Nestors of our profession are wont to give counsel and advice to the rising youth thereof, and sometimes to tell stories of their early struggles. Then we hear how they weltered in a sea of ignorance, or hewed their way with difficulty through pathless forests, with no guide, or, at best, few, and those of doubtful knowledge of the country.

Ingenuous youth is congratulated on the broad roads now laid down for it, the numerous sign posts and the voluble and confident courier at every corner, ready, for a consideration, to take the explorer over the whole country in the latest thing in motor-cars, or, may be, to show him a garden in the wilderness, planned and planted by himself, and warranted far more fertile and fruitful than that of a rival gardener over the way.

The budding engineers are much pleased and flattered at what they have been told. They like to feel themselves "heirs of all the ages in the foremost files of time," and with some few of them the effect may outlast the morning headache, and they may be induced to waste the precious hours of youth over the most unprofitable literature that has yet been invented to plague the souls of men.

No doubt the old stagers were perfectly sincere in their congratulations and regrets. They remember the struggle and have forgotten what it has done for them. *O fortunatos nimium, sua si bona norint* [lucky beggars, did they but know their luck] : probably they owed their success, in no small part, to the very lack which they deplore. Because they had no technical literature, they had to think things out for themselves. Some time might be lost, belike, in the process, but it was well worth while, for the self-reliance and real grasp of the matter attained, which was the making of them.

Such men have contributed enormously to the education of the generation of engineers which followed after ; not so much by writing, though some of them have contributed to technical literature directly, with varying success, but by their example and by personal intercourse, professional or friendly, with their fellow workers in the same profession.

The almost universal dulness of technical literature is a phenomenon which calls for some explanation. It is certainly not due to the subject matter ; science and engineering are not only of absorbing interest in themselves, but also touch modern life at so many points that few people are lacking in curiosity respecting them. It may be in part owing to the technicalities of the language in which it is written, but that ought not to be a drawback to engineers. The cheap retort that the dulness is in the reader cannot pass muster for a moment. No doubt, if a man tries to read what he does not understand, he is not much interested in it ; it were an abuse of terms to say that Homer is *dull* to the man who knows no Greek—it is merely unintelligible to him. But anyone could name half a dozen technical works which he can understand perfectly well, but which he finds too tedious for words. The real explanation, in all probability, is that, even when the authors are engineers, experts in the subject matter, they are amateur writers. They know what they want to say, but they don't know how to say it. They lack skill of expression and arrangement, and especially the knowledge what to omit. Often material is collected from various sources, and thrown at the reader without any attempt at harmonising or assimilating it. Occasionally, of course, a man with a natural talent for writing produces a technical book, and then, provided he be not too hurried and has no pressure put on him to spoil it, a really readable book is the result ; but in general the books are dull, not because the authors are either dull or ignorant, but because they have not learned to write. Fortunately they are rapidly teaching their readers the most important lesson in the art of reading, how to get at the pith of the matter while rejecting the rind ; and if well indexed, so that the search be not too tedious, they do more good than harm.

Another, unhappily far more numerous class, is that of the professed writers of text-books. These *have* learned to write ; only by taking thought could they have achieved the execrable style which jars on every nerve. The usual formula for the composition of such books is :—An introduction exhibiting appalling confusion in elementary mechanical ideas ; water analogy in excess, enough to drive the student to drink—anything but water ; substitutes for Ampère's rule—right-hand rules, left-hand rules, corkscrew rules, and tendrils of the hop and vine—till the reader hardly knows his right hand from his left, or can draw the cork of the next bottle ; a modicum of very elementary mathematics, mostly misapplied ; the preface usually boasts that nothing beyond simple equations will be demanded ; the rest nearly all descriptions of dynamos and motors, or of instruments and switches, according to the title of the text-book ; or padding about engines and turbines, boilers and central stations, switchboards, photometers and lamps, testing, joint boxes, joint making, and so forth. Hardly ever is the information to be relied on implicitly, hardly ever is it full enough on any one point to be of any use to anyone, generally it concerns things much better learned otherwise than from books, but its total mass is enormous and stupefying. The authors seem scarce to know anything thoroughly, but they know enough to make them rather exceptionally good wiremen (given the manual skill), or perhaps even foremen in works—but as writers !—"Break their pens, O Lord, in their hands."

And it is on this hogwash, unpalatable and innutritious, that our rising engineers are to be fed ; it is for this that they are asked to renounce art, science and poetry, polite literature and romance, everything that gives flavour and beauty to life.

Of course, there is something to be said on the other side. The water analogy is a helpful one to the beginner, and is used by the best teachers : the nausea it produces on constant repetition expresses the satiety of a jaded reviewer, but the student will meet it only once, or if he find it a second time will naturally pass it over. Some rule is necessary to express the relations between the magnetic field and the motion of, and E.M.F. produced in, a conductor ; and each writer expects his readers to adopt the rule he lays down. As for the insipidity of their productions, the writers may well plead that they are following a rule almost universal among pedagogues : all text-books, whatever the subject, are expected to be insipid. History, for example, the most delightful and stimulating literature in the world, is absolutely unreadable as presented to schoolboys, a mere farrago of dates and reigns, battles and "principal events." Hardly any surer way of producing a permanent distaste for Shakespeare's plays could be hit upon than the drudgery of getting up an annotated play for examination ; but to pursue this subject would take us too far afield ; it is matter for an essay on education and the blighting effect of the examination system. It is sufficient to point out that a large proportion of the text-books referred to are written with an eye to some examination or other ; London matriculation, South Kensington, or possibly, the Civils ; and to a common cause a common effect may be attributable.

There is a lower deep still—books, written by the ignorant for the ignorant, which, notwithstanding, command a large sale. In writing for the readers of the Electrical Review it is hardly necessary to do more than refer to their existence. After all they do but little harm, and are an indication of an unsatisfied desire for knowledge, in itself praiseworthy. If a workman or shopman prefers to spend his leisure in reading "All about Wireless Telegraphy," "The Story of Radium,"*

* These titles, so far as I am aware, are imaginary.

or "Electricity in the Service of Man,"* it will probably be better for his health and pocket, and not much worse for his intellect than if he were to spend it discussing labour questions, or the odds on the next horse race in his favourite bar.

The technical literature crystallised in library form, however, is only a part of the technical literature of the world: there is an immense fluid mass of it continually being poured forth in the form of papers read before engineering and other societies, contributions to the technical Press, lectures and addresses, communications (not read) to the journals of our various institutions, notes, memoirs and memoranda; bearing much the same relation to permanent technical literature that the newspaper does to history, and destined, no doubt, to furnish material for future books, and for future editions of some that we now have. With an army of clever men engaged in research, in engineering practice, and in design throughout the civilised world, it is only to be expected that the mass of such current literature should be great, and it is the business of the technical Press to deal with it as it appears, and to present it clearly and concisely to its readers. The bearer of good news is welcome though he speak with a stammering tongue, and no one is disposed to be too critical of any real advance in theory or practice, so it be presented intelligibly. But the torrent is swollen and muddied by the intrusion of matter that no one wants. A man has put down a water power installation, has extended a tramway, converted a factory to electric driving, lighted the corporation baths. He has done the work well, it is presumed, perhaps there is some novelty about the work, some special difficulty overcome, or some small fraction of a penny (per unit) saved by a novel point in organisation or design. He reads a paper on it, and is not content to mention what is original or novel, but must tell his long-suffering hearers everything he has done, give them plans, dimensions, tables. He must mention, too, what firm has supplied the stays for his transmission line, the pumps for his engines, or the switches and meters on his switchboard; or, if *he* need not, the unhappy editor who ventures to report him is deluged with letters asking that the deficiency be made good. Another will not even have put his contrivance to the test of experience, but will spin a scheme out of his own head, say, for detecting losses in a generating station, and invite practical engineers to paste his diagrams on the walls of their offices and to reorganise their whole work on his plan. Anyone who invents a new switch, a new meter, a new clamp, wants to talk about it, and that not merely to his chums, which is praiseworthy, but to the whole world of engineers. No wonder that the grains of wheat are apt to be lost in the heaps of chaff and stubble. It is as though every doctor were to ask that every case he treats were to be discussed in the *Lancet*; imagine the result if even a hundredth part of them could get a hearing for a tithe of their communications. Technical literature is the *entropy* of science. We can do nothing without producing it, but our aim should always be to minimise it. Happily, unlike physical entropy, it is not indestructible.

Technical literature being what it is, the question remains what to do with it, since we cannot do without it. A few hints to young readers may be useful:—

If you find a technical book which it gives you pleasure to read, read it and re-read it, and recommend it to your friends. You have found a pearl of great price.

If you find a book dull, don't attempt to read it. It is nearly as wicked to read a dull book as it is to write one, and much more unprofitable. No doubt you might learn something from it, but the moral and intellectual damage on the other side of the account is incalculable. Consult its index and table of contents to see if it has anything you are likely to want, and, if so, put it aside for reference, provided it be well indexed. Otherwise let the second-hand bookseller have it well within six months.

But do not mistake difficulty for dulness. Dulness is an irritant poison, difficulty a stimulant and a challenge. Put it aside for a while and strengthen your attack; next time, probably, the difficulty will vanish.

Read an old book (written before the tradition that an engineer should be a cultured gentleman was obsolete) rather than a new one; if you have the luck to find such a thing. A very casual acquaintance with current journalism will save you from acquiring from it other obsolete ideas. Also read a big book rather than a little one on the same subject. It saves time in the end, and worry, too. But if the bigness be that of a windbag, throw the thing away.

Go to original authorities whenever practicable rather than to compilations, abstracts and text-books; you will have to go there in the end if you want really to know, and it saves time to begin with them.

Cultivate the habit of tearing the heart out of books on some special subject. Take up one for practice, say, transformer leakage, and see what you can find out about it on your shelves. That is one way of relieving the tedium of technical literature.

Read critically, and never take anything for granted. Be especially cautious when a statement begins with "It is evident," or "It is easy to see that." These expressions are danger signals, indicating that the author cannot prove the statement, or has taken it secondhand. Prove it yourself, or distrust it. Sometimes you will find you can disprove it.

Glance at the papers read before the Institution, and if they attract you read them. If not you can safely put them by till they appear in the *Journal*, by which time you will know whether they are worth further notice. Presidential addresses can always be passed over, save in the rare cases where they set everybody talking. Then look to see what the fuss is about.

Take and read some electrical journal, but don't think of reading it from cover to cover. Read what takes your fancy. Technical journalism, in one respect, is the ideal technical literature, in that it lets you know what is going on and leaves you to pick and choose.

Lastly, read what you must, and what you like—the two will be nearly synonymous, if you really love your profession—and let the rest go.

By following the plan sketched above the young engineer will leave himself leisure for lighter pursuits not less essential to his education. He will have a chance of becoming a master of his profession instead of its slave. Before all things it is necessary that he build on a sure foundation of dynamical and mechanical principles, and if in this respect his education has been hurried or neglected he will have time to remedy the defect by underpinning. Thus he will have a touchstone by which to try much of the technical literature he meets with, and will pay little regard to the man who tells him, *e.g.*, that meteors, lampshades, and other falling bodies must needs come down base first. (I think this particular absurdity can be traced back to Jules Verne.) One advantage of mathematical physics is that it can be studied anywhere and without special apparatus; its laboratory is the physical universe. To the mechanically minded man such a proposition as the parallelogram of forces is axiomatic, and to prove it with weights, strings and pulleys is as childish as to prove it by diagrams and Euclidian reasoning is pedantic and absurd. Of the two he will prefer the latter.

Let any engineer who thinks I have undervalued the importance of reading technical books ask himself to what he is indebted for his own knowledge. I fancy he would find himself compelled to put first and foremost his practical experience in workshop and laboratory. Second would come what is picked up in conversation with his friends and fellow engineers. There is no more foolish prejudice than that against talking shop; premising, of course, that no one is shut out of the conversation thereby. Third in importance are lectures, debates (which are mere formal conversations, and all the better the less formal), and the floating literature of papers and journals. Last of all, *longo intervallo*, would come technical books, rather a storehouse of what has been otherwise acquired, than a means of acquiring; useful for reference, but deceptive as a basis of knowledge. For the engineer is indeed a man who works with his brains, but he must think with his fingers. Those whose knowledge comes mainly from books have their minds filled with eidola, and are out of touch with realities, which perplex and annoy them. A boy learns more engineering from his bicycle, especially if it be a motor-bicycle, than from all the primers and diagrams with which he may be crammed, and learns it

* There are two books with this title; the author of each will kindly suppose I refer to the other. As a matter of fact, I have not read, and have no desire to read, either.

in a much pleasanter way. The motor-car, as Mr. O'Gorman once said, is making us, men and women alike, a nation of engineers.

It follows that technical literature should be mainly theoretical. The bridge of the text-book should be a diagram, or if some special pattern be described it should be merely by way of illustration. Details of manipulation, the cleaning of connections, how to put the wire round the binding screw, &c., should be taught orally in the laboratory. Too often the text-books pile one pattern on another till the thing looks more like a maker's catalogue than a book.

Writers of papers should make sure they have something to say worth saying before they rush into print. The great majority of papers reminds one of Millais' picture, "Now all turn round and tee me dump." The egoism is charming in a child, but disgusting in a man. We don't want to see them jump, unless they can jump farther in some direction than anyone else. In short, every paper should constitute a record in its particular line. There might be fewer of them, but what discussions we should have! In the highest department of technical literature of all, that of pure theory, it is above all things requisite to have ideas, to have some message to deliver.

It is this which puts Mr. Oliver Heaviside far and away above all other electrical writers of his time. For this we pardon what would be grave faults in a lesser man: his lack of literary form, his bursts of prejudice and ill temper, his perverted sense of proportion which makes him insist, as a matter of principle, on the elimination of a harmless coefficient, without regard to the enormous practical drawbacks to a radical change of units, even his demand that we shall all learn a new calculus in order to read him at all. Alas! this last condition is fatal to the majority: the air he breathes is too fine for the lungs of ordinary humanity; but there, on the heights, he has a clear vision of the whole field of electric and magnetic energy, and the work of the toilers below melts into an harmonious whole. Would that any could be found to translate that vision into the speech of plain men!

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

6. "Improvements in electro-deposition of metals." S. O. COWPER-COLES. January 1st.

28. "Improvements in electric lamp cap switching." F. HARRISON. January 1st.

42. "Time indicator for persons using the telephone." S. CUNNINGHAM. January 1st. (Complete.)

96. "Improvements in or connected with fuses specially though not exclusively applicable for telephone purposes." A. T. M. THOMSON. January 1st.

97. "Improvements in protective devices for electric transmission systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) January 1st.

98. "Improvements in and relating to electric transmission systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) January 1st.

99. "Improvements in and relating to alternating-current commutating machines." ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT. (Date applied for under Patents Act, 1901, January 29th, 1906, being date of application in Germany.) January 1st. (Complete.)

132. "Improvements in telephony and telegraphy." L. CEREBOTANI and A. SILBERMANN. January 2nd.

139. "Improvements in single-phase induction motors." V. MARTINETTO. January 2nd.

155. "Improvements in and relating to incandescent electric lamps." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) January 3rd.

156. "Improvements in protective devices for electric transmission systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts Gesellschaft, Germany.) January 3rd.

210. "Apparatus for magnetic separation of ore." METALLURGISKA PATENT-AKTIEBOLAGET. (Date applied for under Patents Act, 1901, January 9th, 1906, being date of application in Sweden.) January 3rd. (Complete.)

217. "Improvements in mechanical organs or pianos provided with an electric lighting arrangement for producing luminous effects." C. MARENGHI. January 3rd. (Complete.)

218. "Improvements in and relating to electric arc lamps." THE BRITISH THOMSON-HOUSTON CO., LTD., and C. W. BROOM. January 3rd.

244. "Improvements in or connected with electrical automatic signalling systems for railways." J. SAYERS. January 4th.

287. "Improvements relating to telephone installations having central and ocal exchanges worked by a central battery." SIEMENS BROS. & CO., LTD. Siemens & Halske Akt.-Ges., Germany.) January 4th. (Complete.)

288. "Improvements-relating to telephone exchanges." SIEMENS BROS. and Co., LTD. (Siemens & Halske, Akt.-Ges., Germany.) January 4th. (Complete.)

294. "Improvements in and in connection with registering mechanism for electricity meters." A. BAUMANN. (Date applied for under Patents Act, 1901, January 6th, 1906, being date of application in Switzerland.) January 4th. (Complete.)

298. "Improvements in or connected with magnetic clutches and brakes." H. W. RAVENSHAW, V. G. MIDDLETON and W. E. TOWNSEND. January 4th.

314. "Improvements in or connected with ships' telegraphs." W. C. KEENE. January 5th.

316. "Improvements in dynamo-electric machines." A. L. RHODES and RHODES ELECTRICAL MANUFACTURING CO., LTD. January 5th.

326. "Improvements connected with the lighting of ships' compasses." W. D. WHYTE. January 5th. (Complete.)

327. "Improved means of working and control of petrol-electric and electric cars." W. A. STEVENS. January 5th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

ELECTRIC ARC LAMPS. H. Bevis and A. E. Angold. 24,061A. November 22nd. (Date applied for under Rule 5, Patents Rules 1905, November 22nd, 1905.)

VACUUM TUBE OR TUBES FOR THE PRODUCTION OF VIOLET OR ULTRA-VIOLET RAYS, X-RAYS, OR OTHER RAYS OR COMBINATION OF RAYS OF HIGH OR LOW TENSION CURRENTS. J. C. Bowie and J. H. Phelps. 25,412. December 7th.

CONTROLLING APPARATUS FOR ELECTRIC CIRCUITS. British Thomson-Houston Co. (General Electric Co.) 25,512. December 7th.

AUTOMATIC ELECTRIC SIGNALLING APPARATUS FOR TRAMWAYS. M. Rathborne and H. Fielding. 25,525. December 8th.

BRAKE MECHANISM FOR ELECTRIC CARS. J. H. K. McCollum and J. W. L. Forster. 25,676. December 9th.

ELECTRIC TELEGRAPHY. A. J. Boult. (Lori and Solari.) 25,754. December 11th.

RAIL BONDS FOR ELECTRIC RAILWAYS. H. H. Lake. (American Steel and Wire Co.) 25,858. December 12th.

ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co.) 26,091. December 14th.

MEANS FOR CONTROLLING THE LIGHTS IN RAILWAY CARRIAGES LIGHTED BY ELECTRICITY OR GAS. J. Stone & Co. and A. H. Darker. 26,187. December 15th.

ELECTROLYSIS OF METALLIC COMPOUNDS OR ORES. E. A. Ashcroft. 26,813. December 22nd.

MANUFACTURE OF ELECTRIC INCANDESCENCE LAMP FILAMENTS FROM TUNGSTEN OR MOLYBDENUM OR AN ALLOY THEREOF. A. G. Bloxam. (J. Lux.) 27,002. December 27th.

1906.

ELECTRICAL RESISTANCE MATERIAL. British Thomson-Houston Co. (General Electric Co.) 6,089. March 13th.

ELECTRICAL IGNITION OF GAS LAMPS. Electrical Improvements, Ltd., and A. E. Hacking. 6,441. March 17th.

ELECTRIC ACCUMULATORS. J. Waddell and D.P. Battery Co. 7,808. March 27th.

CONTROLLING OF ELECTRIC MOTORS. H. W. Lake. (Societa Anonima Italiana Gio Ansaldo.) (Armstrong & Co.) 7,418. March 27th.

LIFE GUARDS FOR ELECTRIC TRAMCARS AND MOTOR DRIVEN VEHICLES. J. W. Trotter. 7,452. March 28th.

SPACE TELEGRAPHY. J. S. Stone. 9,412. April 21st. (Date applied for under International Convention, May 4th, 1905.)

SPACE TELEGRAPHY. J. S. Stone. 9,417. April 21st. (Date applied for under International Convention, May 4th, 1905.)

COMBINED ELECTRIC SWITCH AND LAMP-HOLDER. F. R. Connell. 9,763. April 26th.

ELECTRIC MERCURY VAPOUR LAMPS. Siemens Schuckertwerke Ges. 9,960. April 28th. (Date applied for under International Convention, May 31st, 1905.)

ELECTRO-MAGNETIC CLUTCHES. W. Schuster and H. Ast. 13,065. June 6th.

ELECTRIC LIGHT BRACKETS. E. F. Hug. 13,381. June 11th.

ELECTRIC CONDUCTOR MOULDINGS. S. M. Burk. 14,611. June 26th.

INCANDESCING BODIES FOR ELECTRIC LIGHTING AND HEATING PURPOSES. Allgemeine E'ektricitäts Gesellschaft. 18,485. August 17th. (Date applied for under International Convention, August 29th, 1905.)

ELECTRIC CURRENT INDICATOR. H. G. Prested. 18,561. August 18th.

ELECTRIC FURNACES. C. E. Pettit. 132. January 2nd.

SAFETY STARTING AND IGNITING MECHANISM FOR EXPLOSION ENGINES. F. W. Howorth. (Winton.) 154. January 2nd.

VAPOUR-ELECTRIC APPARATUS. British Thomson-Houston Co. (General Electric Co.) 1,116. January 15th.

AUTOMATIC ELECTRIC FUSE INDICATOR FOR SHOWING BROKEN OR BLOWN FUSES. A. F. Webb. 1,727. January 23rd.

METHOD AND APPARATUS FOR TREATING TEXTILE FIBROUS MATERIALS WITH THE PRODUCTS OF THE ELECTROLYSIS OF WATER, SOLUTIONS OF ACIDS, OXIDES AND SALTS. H. Hey. 2,083. January 27th.

ROTARY DISTRIBUTING CONTACTS FOR ELECTRICAL IGNITION IN EXPLOSION ENGINES. H. J. Simmons. 2,761. February 3rd.

ELECTRICAL IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES. H. Bevis and H. J. Coates. 3,258. February 10th.

MEANS FOR ELECTRICALLY REGULATING THE RUNNING OF VEHICLES. R. C. Sayer. 3,471.

NEUTRAL RELAY FOR USE IN DUPLEX AND QUADRUPLEX TELEGRAPHY. S. D. Field. 3,630. February 14th.

SPEED REGULATING AND STEERING APPARATUS FOR ELECTRICALLY PROPELLED ROAD VEHICLES. J. Ogilvy and C. W. Davson. 4,930. February 28th.

MEANS FOR FACILITATING THE ERECTION OF TELEGRAPH POLES AND THE LIKE. J. R. Brown. 5,508. May 7th.

METHODS OF SIGNALLING IN WIRELESS TELEGRAPHY. V. Poulsen. 6,217. May 14th.

DARK LANTERNS FOR USE WITH INCANDESCENT ELECTRIC LAMPS. G. A. Bertalot. (Bonino.) 7,849. April 2nd.

MATRICES FOR USE IN THE GALVANO-PLASTIC PROCESS. H. Schimansky. 8,843. April 12th.

MANUFACTURE OF FILAMENTS OF TUNGSTEN OR MOLYBDENUM FOR ELECTRIC INCANDESCENCE LAMPS. A. Bloxam. (J. Lux.) 9,020. April 14th.

CONTROLLERS FOR ELECTRIC MOTORS. H. U. Hart. 12,492. May 29th. (Date applied for under International Convention, June 12th, 1905.)

TELEGRAPHY. I. Kitsee. 12,748. June 1st.

STARTERS FOR ELECTRO-MOTORS. L. Harris. 12,895. June 2nd.

ARRANGEMENT OF THE WINDING OF ELECTRIC-MAGNETIC CLUTCHES. W. Schuster and H. Ast. 13,069. June 6th.

MEANS OF WORKING AND CONTROL FOR PETROL-ELECTRIC CARS AND ELECTRIC CARS. W. A. Stevens. 13,903. June 18th.

INDUCTION COILS. S. H. Sauvé and J. H. Robinson. 13,946. June 18th.